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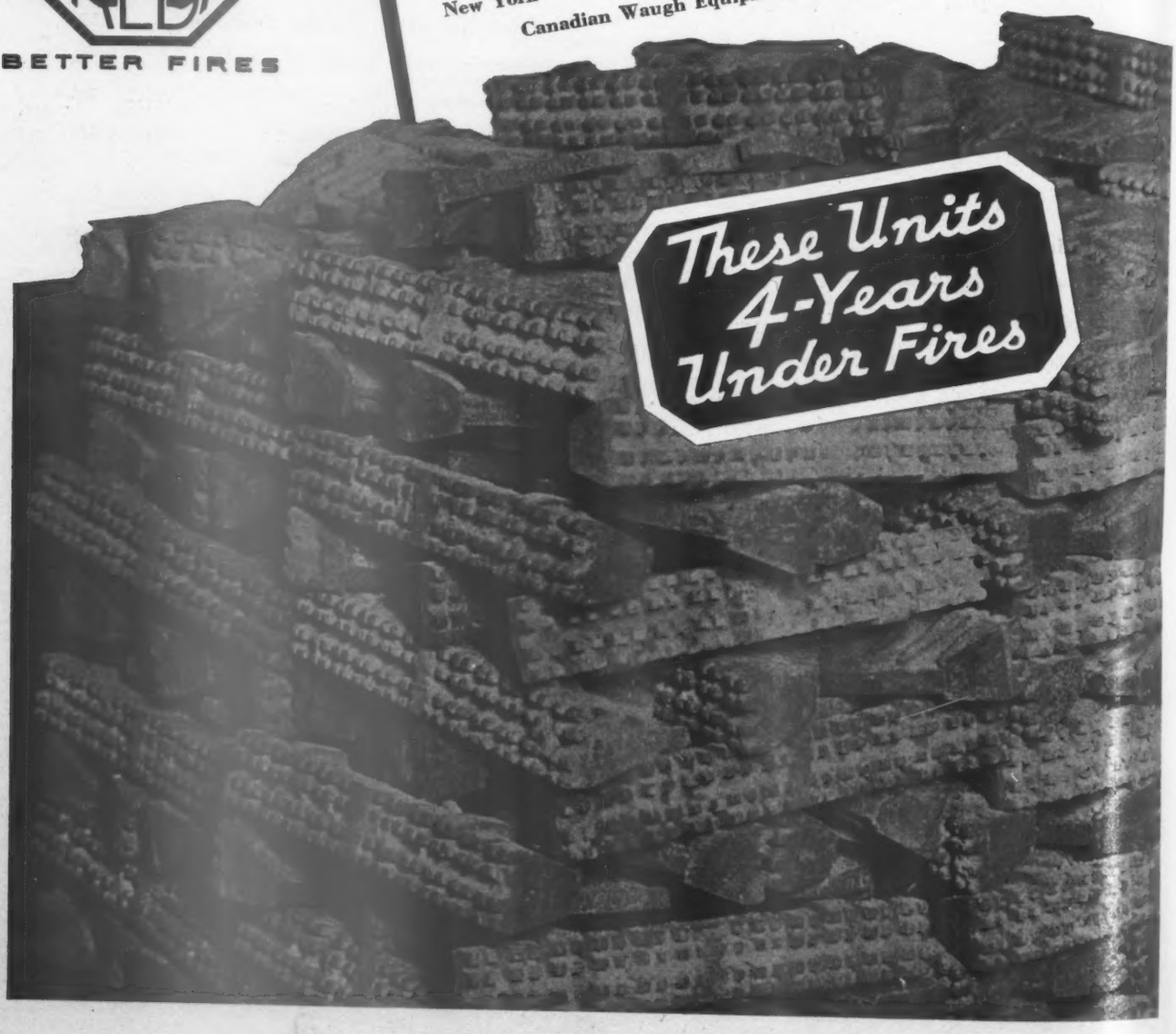


The new "Super Chief"

Lightweight Cars for the

Sante Fe "Super Chief"

Nine cars of stainless-steel construction, built by the Edward G. Budd Manufacturing Company, embody luxurious fittings and a unique scheme of decorative treatment

On May 18 completely new equipment was placed in service on the Super Chief of the Atchison, Topeka & Santa Fe. This train, which makes a round trip each week on a one-way schedule of 39¾ hours between Chicago and Los Angeles, Calif., now consists of nine lightweight cars, built of stainless steel by the Edward G. Budd Manufacturing Company. Since the cars were placed in service a new 3,600-hp. Diesel-electric locomotive has been delivered to the railroad by the Electro-Motive Corporation and this locomotive is now regularly assigned to the Super Chief.

Unlike the trains previously built by the Edward G. Budd Manufacturing Company, the Super Chief is made up of separate coaches, without articulation. The exterior, however, is completely sheathed with stainless steel in narrow, curved, longitudinally beaded panels below the windows, flat sheets between the windows and corrugated sheets above the windows and on the roof. The surface is not painted, except for the lettering on the letterboards and the name plates.

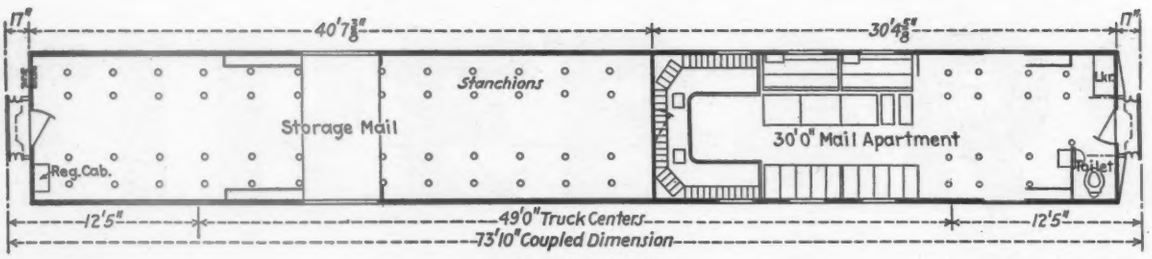
The cars are built without hoods, conforming in general external appearance to coach No. 3070 which this builder completed for the Santa Fe early in 1936, except that the apron below the sides of the cars has been removed opposite the trucks.

The consist of the train is shown in a table. The total weight of the train ready to run, exclusive of motive power, is 851,000 lb. There are berth accommodations for 104 passengers, with 42 seats in the observation lounge and cocktail lounge and seats for 36 in the dining car. Bunks in the crew quarters accommodate 12 persons.

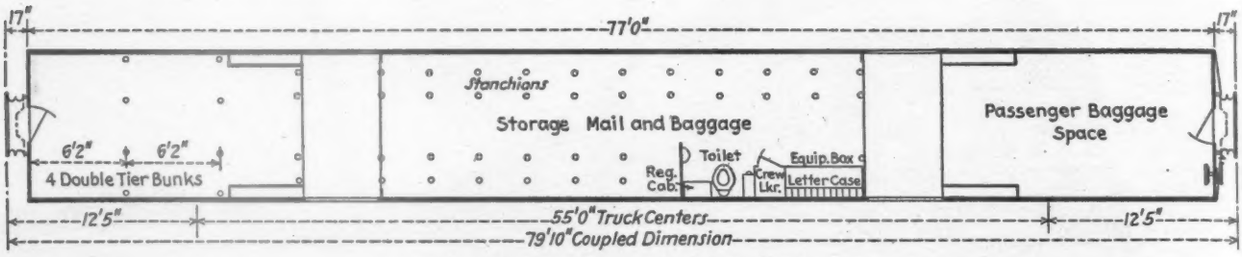
The Car Structures

The car structures are fabricated from the so-called 18-8 stainless steel by the Budd Shotweld process, except for the end, underframes and bolsters which are Cromansil fabricated by the Lukenweld process. Two types of stainless steel, based on physical properties, were used in building this train. The high-tensile material has a unit strength of 150,000 lb. per sq. in. and is generally employed in the strength members of the structure. The low-tensile material with a unit strength of 100,000 lb. per sq. in. is used where ductility or special finish is of paramount importance.

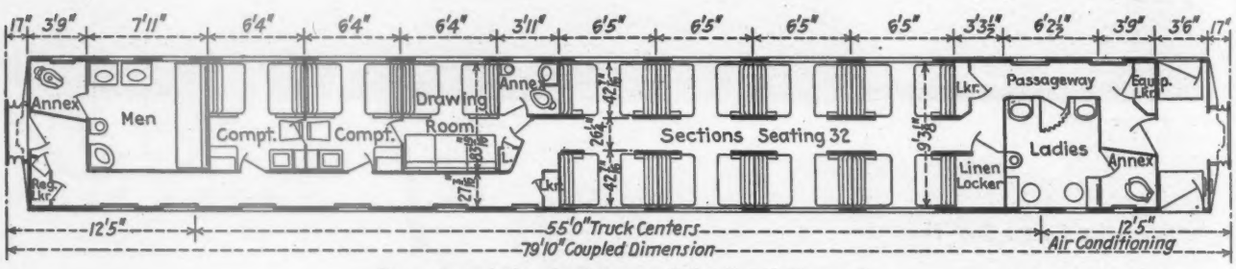
A number of changes have been made in details of the structure as compared with those employed in Santa Fe coach No. 3070. In that car a departure was made



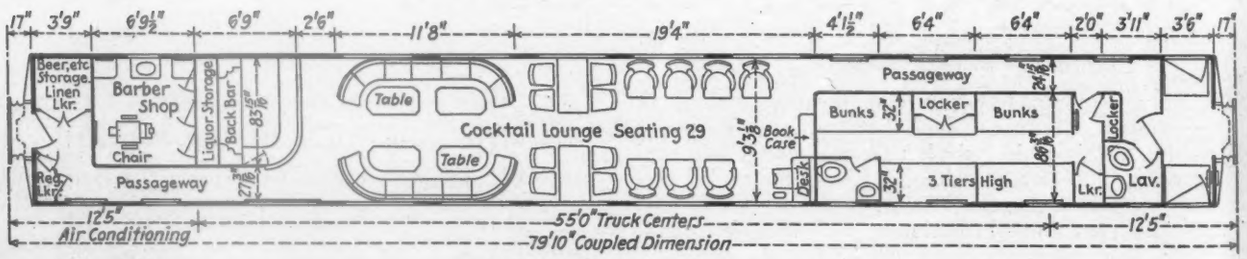
Postal car No. 3400



Storage-mail and baggage car No. 3430



Floor plan of the sleeping cars "Isleta" and "Laguna"

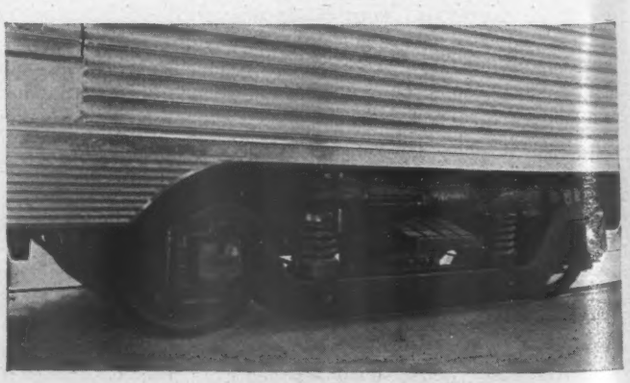


The cocktail lounge car "Acoma"

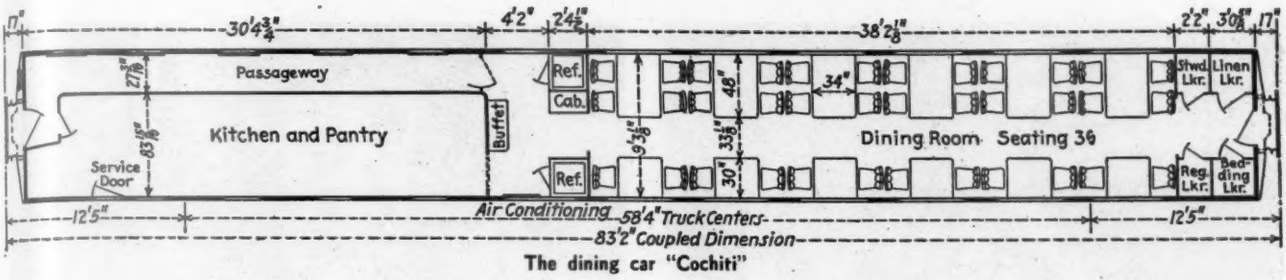
from the truss form of side-frame structure characteristic of all of the other trains built by this company. Wide vertical members of channel section were placed between the windows. In the cars of the Super Chief a return has been made to the modified Pratt truss type of structure, using narrower vertical channel members and diagonals in the panels between and below the windows.

The underframe structure is essentially that employed in coach No. 3070, except that the channel-section floor stringers have been replaced by members of Z-section. This marks a further step in the progressive simplification of the Budd type of construction by which the number of pieces and amount of welding have been reduced.

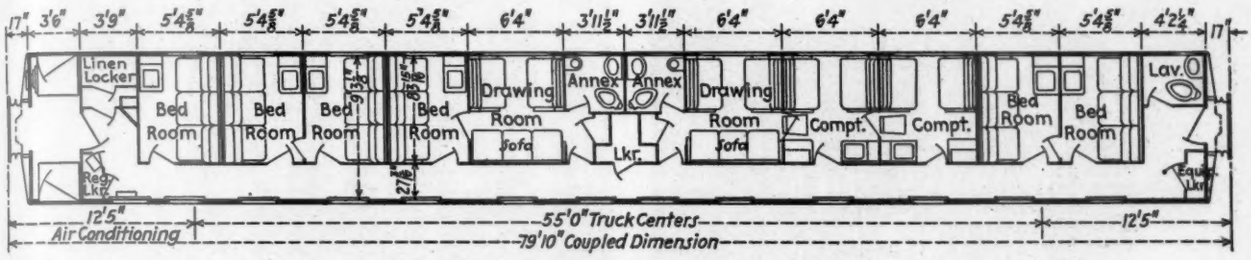
With the exception of postal car No. 3400, the dining car "Cochiti," and the sleeper-observation car "Navajo," the car bodies are essentially of the same overall dimensions as the first coach No. 3070. They are 79 ft. 10 in. coupled length; 10 ft. ⅛ in. outside width, and 13 ft. 6 in. in height above the rail. Inside, the width is 9 ft. 3¼ in. The mail car is 73 ft. 10 in. in length; the dining car, 83 ft. 2 in. in length, and the sleeper-observation car, while not appreciably longer than the other sleeping



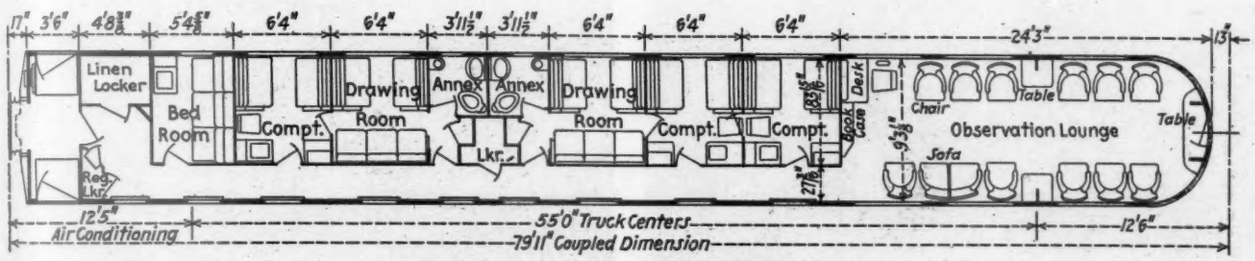
One of the double-equalizer trucks



The dining car "Cochiti"



Floor plan of the sleeping cars "Oraibi" and "Taos"



The compartment-observation car "Navajo"

Arrangement of the open sections in the "Isleta" and the "Laguna"

cars, is built with a curved rear end, over which the roof is hooded.

The center of the roofs is insulated with 2-in. Dry Zero. The roofs adjoining the side walls, the side walls and end walls are insulated with 3 in. of the same material. All of the hollow structural members are filled with Kimsul. The space between the tops of the cross-bearers and the under side of the corrugated floor sheets is filled with Hairfelt or Salamander. The floor consists of 1 in. of cork laid over the corrugated floor sheets, the recesses of which are filled with cork strips. Above the cork is a ¼-in. Super Pneu pad on which the carpet is laid.

The ceilings and side walls of the cars are generally finished with Masonite which, on the walls, forms the base for the Flexwood surface and, on the ceiling and parts of the walls, has a painted finish. The partition frames are of carbon-steel tubes of square cross-sectoin to which the Masonite is applied by Shakeproof self-tapping screws. The Masonite is insulated from the steel work by strips of gummed cork-felt tape.

The outside doors throughout this train are so constructed as to fit flush and present a continuation of the body surface when closed. The passenger doors are fitted with O. M. Edwards folding steps, which, when not in use, are folded up to close the step well with an outside surface similar to that of the body proper. The steps are faced with aluminum Diamondette treads with a nosing of punched and formed stainless steel as a guard against slipping.

The interior doors are hinged in such a manner that there is no possibility of pinching, without the use of anti-pinch plates.

Installing the channel floor sheets

The side frame is of truss form

The windows in the passenger occupancy sections of these cars are double glazed with the outside glass fixed in the car body and the inner glass mounted in a hinged frame. The inner glass can be unlocked and swung inward to permit cleaning. The glass in both frames (inner and outer) is set in rubber to eliminate the transfer of any strain to the glass. A rubber gasket seals the space between the inner and outer sash. A departure from standard practice is the arrangement of small windows in the letterboard area of the open sections for the use of the upper-berth occupants. These are of the same construction as the large windows with their fixed outer sash and hinged inner sash. Small windows in the aisles, in the kitchen, and in the rear of the last car are of the movable type and are provided for emergency ventilation and to facilitate terminal servicing. All plain glass is shatterproof, ¼ in. thick.

An Innovation in Berth Construction

Each of the open sections in the first two sleeping cars embodies a maximum of privacy by being partially enclosed by a narrow longitudinal partition extending each way from the aisle side of the section partitions. Additional comfort is assured by making all of the berths 6 ft. 5 in. in length. Mishawaka rubber mattresses are used.

A further innovation in berth arrangement is the construction of the upper berth. Instead of swinging upward when in day position and forming a curved side ceiling, it is pushed up to a daytime position parallel to the night position, forming a flat ceiling over the section, the narrow opening between the car ceiling and the upper berth being enclosed by the upper berth curtain. The flat upper-berth tray is supported by rollers on four spindles projecting from the ends, one at each corner, into recessed guides in the partitions between the sections. From the day position the upper berth is lowered by first slightly lifting and moving the front of the berth toward the aisle when it will drop to the night position. By a similar operation the back of the berth is then dropped. Because the upper-berth tray is flat, more head room is available for the occupant of the lower berth.

The upper berth is restored to the daytime position by first lifting the rear side, completing the movement by lifting the aisle side of the tray. The berth is securely locked in day position because the supporting spindles and rollers are held in the ends of the guides by gravity a position from which they can be moved only by lifting through a slight initial elevation in the guides before they are free to drop to the night position.

Interior Decorations

The creation of the architectural and decorative treatment of the car interiors is the result of the collaboration of Paul F. Cret, Philadelphia architect, and S. B. McDonald, designing engineer and decorator of Chicago. Roger W. Birdseye, advertising manager of the Santa Fe, collaborated in the application of the southwestern Indian motif, especially in the observation lounge.

The result is that the interior decorations and upholstery of the new train suggest the country and the native traditions of the Southwest through which it operates. The colors follow those found in the land-

scape and in the Navajo Indian craft and ceremonial traditions. The Flexwood wall coverings of the sections, the drawing rooms, compartments and bedrooms are in a variety of rare woods, with adjoining surfaces painted in harmonizing colors. A few of the combinations are figured red gum, with flesh colored ceiling and mist taupe carpet; white harewood, with lemon cream and Vienna drab on other painted surfaces, and a jade green carpet; satinwood set off with blue gray, and a carpet in modern blue; redwood burl, with peach and blue-gray, and a mahogany carpet; Macassar ebony, with peach and light chocolate, and a Rumba carpet.

In the cocktail lounge two items of particular interest are the inlaid wood back bar ornament and the rug hanging over the desk at the opposite end of the room. The subjects displayed here are as a rule never executed in enduring mediums. These "sand paintings" as they are called are religious pictures which have lived between

Looking toward the rear end of the cocktail lounge

ceremonials only in the memory of the people. The rug is true Navajo, and the back bar inlay is an authentic reproduction.

The observation lounge in the last car also displays the work of the early southwestern Americans. The chairs and sofas are upholstered in a reproduction of native weaving, the original of which has been selected for museum display. The ornamentation of the pier panels employs authentic copies of sand paintings. These figures are executed in native colored sands and charcoal, exactly as Navajo prophets have made them for generations.

A photo mural of Navajo weavers at work on their looms hangs over the desk at the forward end of the observation lounge.

Electrical and Air-Conditioning Equipment

The electric power is 32-volt, d.c., supplied by Exide 850-amp. hr. batteries charged by Safety 7½-kw. body-hung generators with flat-belt drive from axle pulleys. Wire is carried in thin-wall steel conduits where practicable. In partitions the square steel structural tubing is fitted with adapters and used to carry the wires. The lighting circuits are protected with fuses in conveniently located and labelled panels.

All lighting is direct. The Safety fixtures are for the most part especially designed to present an appearance in harmony with the decorative schemes employed and to furnish satisfactory lighting.

Conditioned air, composed of a controllable amount of fresh air from the outside and recirculated car air, is supplied to all passenger occupancy sections of this train. Both fresh and return air are filtered through washable metal filters before being passed over coils for cooling or heating. The subsequent delivery by insulated metal ducts and through lighting fixtures furnishes air to all parts of the train occupied by passengers. Special branch ducts carry air to the berths of the sleeping sections.

The Safety-Carrier steam-ejector equipment is mounted below the car floor, and the cooling coils are mounted

Navajo "Sand Painting" figures on the observation wall

between the false ceiling and the roof. Vapor temperature-controls are fitted, and the ratio of fresh to recirculated air is controlled by manually operated dampers. Exhaust ventilators are fitted in the roofs over the toilets.

The passenger cars are equipped with the Vapor heating system. Individual thermostatic control is provided in each drawing room, stateroom and bedroom.

Water System

All service water for the passenger cars is carried in stainless-steel tanks, mounted under the cars, from which it is delivered by air pressure to the various outlets. The

system used in the dining car is similar, except for the addition of overhead storage tanks, one for hot water and one for cold filtered water. The water system in the railway post office and the mail-storage cars is similar to existing equipment; i.e., gravity feed from overhead tanks. Separate tanks are installed beneath the floor of passenger cars to carry the make-up water for the air-conditioning equipment. Filler inlets are placed in the sides of the car body to permit rapid and easy filling at the water stations.

Water coolers fitted with self-closing taps are located throughout the train for the convenience of passengers as well as in the kitchen and bar. The sleeping rooms are fitted with water carafes made on the vacuum-bottle principle and which the attendant will fill at the water coolers in the aisle.

All plumbing fittings and fixtures are of high quality. Washstands are vitreous china, colored to harmonize with the washroom interiors; hoppers are furnished with porcelain bowls, and the dental bowls are of the same material and color as the wash basins. All exposed piping is satin-finished chrome plated.

The trucks are four-wheel double-equalized type with Commonwealth integral frames and transoms of cast nickel steel, double annealed and drawn.

The frames are designed to withstand 200 per cent braking power. All bearing surfaces are carefully machined and all brake-pin holes are bushed with case-hardened sleeves. Surfaces subjected to friction are faced with manganese steel liners, and unfastened metal-to-metal contacts are insulated with sound-deadening material. The trucks on the first five cars are fitted with friction type bearings in Symington boxes with Magnus Company Satco bearings, the Freedom rolled-steel wheels on these being 35 in. in diameter. The trucks on the last four cars are fitted with American Steel Foundries roller-bearing units with SKF roller bearings. All axles are nominal 5½ in. by 10 in.

The coil truck springs are made of silico-manganese steel, and the elliptic springs of chrome-vanadium steel. Lateral movement of the truck bolster is dampened by the use of Houde hydraulic shock absorbers.

The cars are fitted with American Steel Foundries light-weight, high-tensile, controlled slack couplers, and Miner A4XB draft gears. The buffers are Miner B18X. The coupler-suspension guide, as well as the buffer stems, are Fabreeka surfaced.

All water, air and steam piping is made of soft heavy-wall copper tubing. Standard fittings are attached by the use of Parker adapter joints.

High Tractive Force and Large Tanks Feature

R. F. & P. 4-8-4 Locomotives

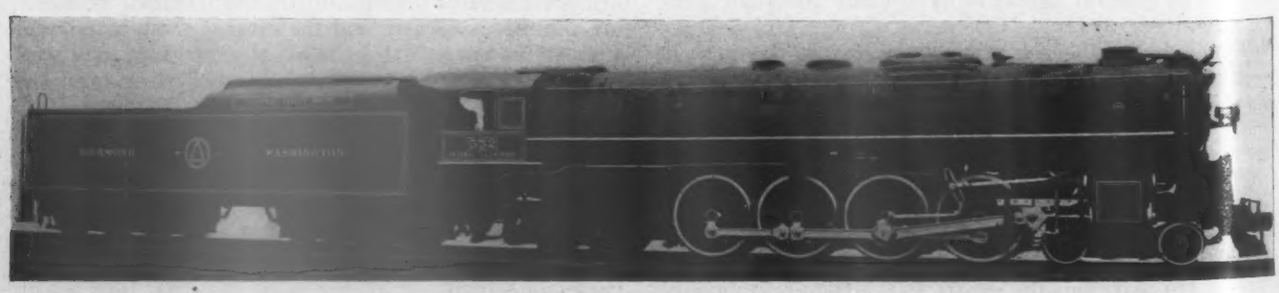
Five motive-power units, built by Baldwin, are designed for fast freight and passenger service; have 77-in. driving wheels and 20,000 gal. tender tanks

THE Richmond, Fredericksburg & Potomac has recently added to its motive-power equipment a group of five 4-8-4 type locomotives built by the Baldwin Locomotive Works which have been especially designed to handle heavy trains on fast schedules over the 118-mile line between Richmond and Washington. This line is, in effect, a "bottle neck" between the South and the North and handles a large volume of exceptionally high-class traffic consisting chiefly of fruits and vegetables bound for northern markets and a large number of all-Pullman passenger trains during the winter months.

These locomotives are built with 77-in. drivers and have a tractive force of 66,500 lb., without booster. One of the five units is equipped with a trailer booster of 16,200 lb. tractive force and all have been arranged for the subsequent application of boosters. The tender tanks have a capacity for 20,000 gal. of water and 22 tons of fuel. They are designed to operate on curves as sharp as 18 deg., to meet a height limit of 15 ft. 6 in. and a width limit of 11 ft. 1 in. The maximum allowable weight per pair of driving wheels is 69,000 lb. The ratio of adhesion is 4.18.

Boiler and Boiler Accessories

The boiler has a conical ring in the middle of the barrel, with a maximum outside diameter of 98¼ in. Nickel steel, having a minimum tensile strength of 70,000 lb. per sq. in., is used for the shell courses, wrapper sheet (roof and sides), back head, and all inside and outside welt strips and liners. The firebox seams and the



The General T. J. Jackson, one of the Richmond-Washington Line's five new locomotives

seam around the firedoor opening are welded, and all tubes and flues are welded into the back tube sheet. There are two syphons in the firebox and one in the combustion chamber. The working pressure is 275 lb. and the boiler was tested under a water pressure of 344 lb. and a steam pressure of 330 lb.

The boiler accessories include Firebar grates and the Standard type HT stoker, with the stoker engine on the tender. The A.A.R. self-cleaning front-end arrangement is applied to three locomotives and two are equipped with the Cyclone front-end arrangement. The stack has an internal diameter of 23 in. and exhaust nozzles having diameters of 7¾ in., 7⅞ in. and 8 in. are furnished, provision being made for boring the nozzles out to a 10-in. diameter if desired. The superheater is a Type E, and an American multiple front-end throttle is built into the header. The feedwater heater is a Worthington, No. 5-Sa, of 9,000 gallons capacity, with the cold-water pump on the left side of the locomotive, back of the rear truck, and the hot-water pump mounted on the left-hand side of the smokebox.

General Dimensions, Weights and Proportions of the R. F. & P. 4-8-4 Type Locomotive

Builder	Baldwin Locomotive Works
Type of locomotive	4-8-4
Road Class	16-48-2/4-E, 106
Road Numbers	551 to 555
Date built	1937
Service	Passenger and fast freight
Dimensions:	
Height to top of stack, ft. and in.	15-6
Height to center of boiler, ft. and in.	10-7
Width overall, in.	11-1
Cylinder centers, in.	92-½
Weights in working order, lb.:	
On drivers	277,245
On front truck	86,725
On trailing truck	102,070
Total engine	466,040
Tender	376,900
Wheel bases, ft. and in.:	
Driving	20-0
Engine, total	47-0
Engine and tender, total	97-2¼
Wheels, diameter outside tires, in.:	
Driving	77
Front truck	36
Trailing truck	42
Engine:	
Cylinders, number, diameter and stroke, in.	two, 27 × 30
Valve gear, type	Walschaert
Valves, piston type, size, in.	12
Maximum travel, in.	7½
Steam lap, in.	1 7/16
Exhaust clearance, in.	¼
Lead, in.	¼
Cutoff in full gear, per cent	82.6
Boiler:	
Type	Conical
Steam pressure, lb. per sq. in.	275
Diameter, first ring, inside, in.	86
Diameter, largest, outside, in.	98¼
Firebox, length, in.	144⅜
Firebox, width, in.	96¼
Depth at back, in.	73
Depth at front, in.	92
Combustion chamber length, in.	77
Thermic syphons, number	three
Tubes, number and diameter, in.	73, 2¼
Flues, number and diameter, in.	205, 3½
Length over tube sheets, ft. and in.	21-0
Fuel	Bituminous
Grate area, sq. ft.	96.3
Heating surfaces, sq. ft.:	
Firebox and comb. chamber	418
Arch tubes	19
Thermic syphons	114
Firebox, total	551
Tubes and flues	4,823
Evaporative, total	5,374
Superheating	2,093
Combined evap. and superheat	7,467
Tender:	
Style or type	Rectangular
Water capacity, U. S. gal.	20,000
Fuel capacity, tons	22
Trucks	Six-wheel
General Data, estimated:	
Rated tractive force, engine, 85 per cent, lb.	66,500
Rated tractive force, booster, lb.	16,200*
Total rated tractive force, lb.	82,700*
Speed at 1,000 ft. per min. piston speed, m.p.h.	46
Piston speed at 10 m.p.h., ft. per min.	218
Weight Proportions:	
Weight on drivers ÷ weight, engine, per cent	59.5
Weight on drivers ÷ tractive force	4.18
Weight of engine ÷ comb. heat surface	62.4
Boiler Proportions:	
Firebox h.s. per cent comb. h.s.	7.37
Tube-flue h.s. per cent comb. h.s.	64.5
Superheat surface per cent comb. h.s.	28.1
Firebox h.s. ÷ grate area	5.73
Tube-flue h.s. ÷ grate area	50.1
Superheat. surface ÷ grate area	21.7
Comb. h.s. ÷ grate area	77.6
Tractive force ÷ grate area	692.0
Tractive force ÷ comb. h.s.	8.91
Tractive force × dia. drivers ÷ comb. h.s.	686.0

* Only one of the five locomotives is equipped with booster.

Engine Bed and Running Gear

A one piece bed, furnished by the General Steel Castings Corporation, with air reservoirs, cylinders and back cylinder heads cast integral, is used in this design. The pistons are steel castings of the Z-type, and the guides are of the multiple-bearing type, with tinned surfaces. Bearing areas are so proportioned that the bearing pressure of the crosshead on the guide does not exceed 35 lb. per sq. in. Elfur iron is used for the cylinder and steam-chest bushings, the piston bull rings, the steam-chest valve bull rings and packing rings, and also for the stationary bushings on the main-rod back ends and the middle connections on the side rods. The rods are Standard Steel Works forgings, machined and polished. Walschaert valve motion is used, and is controlled by a Lewis Type A power-reverse gear. The valves have a steam lap of 1 7/16 in. and an exhaust clearance of ¼ in. They are set with a maximum travel of 7½ in. and a lead of ¼ in., and cut-off takes place, in full gear, at 82.6 per cent of the stroke.

Baldwin disc driving-wheel centers are used on these locomotives. The centers are of special Double-Anchor high-tensile steel, cast by the Standard Steel Works. The Alco lateral cushioning device, arranged to provide a lateral movement of ½ in. on either side, is used on the leading pair of drivers.

Baldwin bearing metal is used for the rods and also for the driving, engine-truck, trailing-truck and tender-truck boxes. The American Steel Foundries roller-bearing unit is used on the front engine truck.

Miscellaneous Accessory Equipment

A mechanical lubricator on the right-hand side, operated from the top of the combination lever, has four feeds to the guides, four to the cylinders, two to the steam chests, one to the air pump, one to the hot-water pump, and one to the trailer truck. A two-feed hydrostatic lubricator has one feed to the stoker engine and one feed blank, except on the booster-equipped locomotive, on which the second feed is connected to the booster engine.

The air-brake equipment is arranged for the application of the Union Switch & Signal Company's two-speed continuous inductive automatic train control and train stop. The limiting speeds are 50 miles an hour in freight service and 75 in passenger service. The front engine truck is braked, as well as the drivers and tender trucks.

The tender frame is a one-piece steel casting of the water-bottom type, with the stoker support cast integral. The forged-steel tender-truck wheels and axles were supplied by the Standard Steel Works.

Particular attention has been given the appearance of these locomotives, and the finish and paint work, which includes polished machinery parts and a certain amount of color, are most attractive.

The locomotives are named after noted Confederate generals of the Civil War, the numbers and names being as follows: No. 551, General Robert E. Lee; No. 552, General T. J. Jackson; No. 553, General J. E. B. Stuart; No. 554, General A. P. Hill; No. 555, General J. E. Johnston.

The principal dimensions and weights of these locomotives are shown in the accompanying table. The locomotive illustrated is the General T. J. Jackson, No. 552.

How Victorian State Railways

Train Apprentices

By Donald Cameron*

Several unusual methods are incorporated in the very thorough plan which is now in effect

THE Victorian State Railways have for many years past trained the great majority of their own craftsmen, and it is generally recognized in the Commonwealth of Australia that their system of training apprentices to become high-class tradesmen is second to none on that continent. Many of the leading positions in large private engineering establishments and other government departments are filled by men who served their apprenticeship with the Victorian Railways.

3,200 Apply for 70 Places

The field of selection for apprenticeship is wider than that in industry generally. Under the Railways Act applications must be publicly advertised throughout the state and all the eligible candidates must be interviewed by an independent board of three selectors (usually comprising a member of the staff board and two departmental engineers) appointed by the Governor-in-Council. To be eligible for appointment, lads must be between 15 and 18 years of age, unless they hold the diploma or intermediate certificate of a technical school, or the intermediate or school leaving certificate of the University, in which event they are eligible so long as they have not reached 19 years of age.

The selectors are not permitted to acquaint themselves with the name of any applicant, who is known to them by number only, and no person is permitted to make representations to them. The number selected must not exceed twice the number of vacancies, and selected candidates who pass the qualifying educational and medical examinations ballot to determine the order of appointment to the vacancies. Those who do not succeed in obtaining immediate appointment are eligible without further application or selection to fill any other vacancies which may arise during the ensuing twelve months.

Country lads who are obliged to reside away from home while serving their apprenticeship are granted an allowance in the earlier years over and above the ordinary wage towards the cost of their board and lodging. The positions are very much sought after and in 1934 we had 3,200 applications for 70 apprenticeships.

Technical Instruction

During the first three years of their apprenticeship, the lads are given part-time technical instruction during working hours, either at the Departmental Technical College, which is situated close to the main metropolitan workshops, or at the local technical school in the case of those located at country workshops. The apprentices are graded in classes according to their previous educational and technical qualifications. The cost of this instruction is paid by the department. Most of the apprentices attend evening technical classes, in addition, at their own expense. The Railways Technical College is in charge of highly trained technical instructors selected from the state education department, and a keen personal interest is taken by the instructors in the welfare of the apprentices under their control.

Apprentices in the higher trades who obtain the best all-round results are eligible each year for monetary prizes and for two or three scholarships which entitle them to attend the full four years' day course at the Melbourne Technical College for the diploma of mechanical or electrical engineering. A scholarship is also open each year for the best all-round apprentices to enter a course for the degree of bachelor of mechanical and electrical engineering at the Melbourne University. The scholarship winners are paid a salary of approximately $600 per annum and, after graduating, are promoted to the junior professional staff and then become eligible for future advancement to higher professional and executive positions.

A supervisor of apprentices is responsible for keeping in touch with all apprentices and their foreman. He checks up to see that they receive proper training in the all-round duties of their trades. He also acts as a "father" to the lads and devotes special attention to those who are living away from home. A report is furnished to the parents every term showing the progress made by the apprentices at their work and in their technical studies.

Visits to Other Plants

Every year a party of from 15 to 20 apprentices is selected to visit leading engineering establishments in other States. They are accompanied by the principal of the Technical College and the supervisor of apprentices, and each is required on his return to submit a paper setting out his impressions of the establishments visited. They are furnished with free transportation and are paid their wages and expenses. The establishments visited include such places as the modern steel works of the Broken Hill Proprietary Company at Newcastle; large electrical power houses; car-building workshops; locomotive workshops; electrical apparatus factories and such like.

These visits have been most helpful in widening the outlook of the apprentices and in developing their powers of observation. They have led to the establishment of a Junior Artisans' Society which organizes visits at week ends, holiday periods, and in the evenings to leading business establishments. This society has developed greatly and has assisted in promoting a spirit of pride in the job.

The system of yearly visits by apprentices to other States has been followed by the neighbouring state rail-

* Mr. Cameron is chairman of the Railways Staff Board and is responsible for the general supervision of matters relating to the appointment and training of apprentices. He visited U. S. A. in 1927 with an Australian Industrial Mission, appointed by the Commonwealth Government to study industrial conditions. He remained in the United States and Canada for several months studying railroad practices.

ways of New South Wales and South Australia who have found it advantageous.

Encouraged To Travel Abroad

When they have served their time, apprentices are encouraged to travel abroad to widen their knowledge and experience, and they are granted extended leave of absence without pay for this purpose with a guarantee that their jobs and seniority will be conserved during their absence. Many have visited the United States of America and other countries and have been afforded facilities to acquire experience through the courtesy of leading railroad and engineering companies in U. S. A. and overseas. Many others have been granted leave to gain experience as marine engineers on overseas boats.

The Railways' Administration regards its apprentices as a valuable asset and is always willing to do anything within reason to help them to become efficient. This is appreciated by the apprentices themselves, and the great majority of them remain with us and adopt the railways as their career.

During the depression it, of course, became necessary to suspend the appointment of apprentices in the railways as in private industry, but with the improvement in economic conditions, the appointment of apprentices at regular intervals has been resumed.

Essentials of

Journal-Packing Specifications

By J. J. Callahan*

What should the railroads do about journal-packing specifications? The author's views on the essential qualities and required inspection of packing are pertinent to this problem

THE important point in the lubrication of a car journal is to get the lubricant on the bearing surface. The less it costs to do this efficiently, the better for the transportation industry. One thing favorable to the present standard system, in which the medium for oil conveyance is textile material known as packing waste, is that it has a low initial cost. Its ultimate cost depends, of course, on its efficiency, about which we do not know very much, because no sincere attempt has ever been made to develop this to its highest state of perfection.

Of all the phases of the standard car-journal lubricating system, the medium for conveyance of the lubricant to the bearing surface has received the least attention and is the least understood. If anybody knows exactly what the medium of oil conveyance in the standard system should be to achieve its highest purpose, they have not published what they know, not at any rate, in the place where it would most reliably be expected to be found. There is not a specification for car journal packing that it satisfactory, and there are some that are very poor.

It might be supposed by the uninformed that if he took what is perhaps most recognized as the best official journal packing specification, and submitted it as is, which is frequently done, to an unknown dealer who had never made packing waste for him before, the required material would, without further delay or inconvenience, be immediately forthcoming. Nothing could be further from the truth, and such a very uninformed person would have quite a little to learn about the uncertainties of car-journal packing. This is not the fault of the dealer who cannot very well make material when he does not know what to make.

Instead of promptly preparing the material as called for in this indefinite specification, the dealer will invariably endeavor to obtain a sample of the waste in use, and after securing it he immediately prepares a packing to match the quality and appearance of the sample, which means that he makes the waste to meet a price and not to the specification submitted. How this gets by is simple enough—nobody knows the difference. If they do they cannot prove anything because almost any conglomeration of textile threads will meet the requirements. The only reason the dealer asks for a sample is to play safe. It is true that the specification was never intended for use in just this way, but, nevertheless, that is the way it is being used.

The Inspection of Journal Packing Waste

When a purchaser receives packing waste he cannot verify its quality as stipulated in the usual specifications. It is even doubtful if anybody tries. The very fact that railroads, claiming to know that waste purchased by them meets the terms of their specifications, rely for their knowledge on the unnecessary expense of personal inspection during manufacture, is a glaring admission of inability. It is very doubtful if they can verify the quality of packing waste to the terms of the usual specification even by a plant inspection.

Plant inspection of journal packing is a sort of policing operation in which the inspector inspects by standing around in the dealers plant asking questions perhaps, and watching the dealer to see that he actually puts into the packing mixture what he, or some other dealer, has already showed to the inspector as the proper material required by the terms of the specification. The strange part is that the dealers rather like this affair. Everybody likes it. There are at present but a very few of us who do not like it.

Only the psychic individual can look at the textile material and discern the true wool or cotton content of the finished packing. Only the same kind of person can tell the content of threads below a certain limit as laid in the mix, if there is any value at all in knowing the

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length as laid in the mix or after being mixed. Only such a person by inspection can separate the finished packing into its component parts of Axminster, ingrain, or Brussel, grades of merino, camel hair, cop, spooler or slasher, that is, presuming he can even identify these fibers in their varying grades of quality.

To determine definitely the important constituents of packing waste, reliance must be placed absolutely on laboratory examination. Therefore, if you want definite information, and that is what you must have if you really intend to do anything, you must make a laboratory examination which is the only reliable and the only kind of inspection necessary or needed. Plant inspection of a kind may have merits where it is but a matter of simple mechanical measurements, but when it comes to invisible requirements to be determined by indirect means and methods not entirely simple and mechanical, a certain method of technique is needed that is not likely to be acquired from shop, yard, enginehouse or drawing board. Hence, why bother at all with plant inspection of journal waste which is after all but a futile gesture in the wrong direction.

The Medium for Conveyance of the Lubricant

However, the real important matter is to get the lubricant on the bearing, both efficiently and at low cost. The low-cost way is the old way. How efficient is the old way remains to be seen. It has done very good work for very many years. Perhaps it has greater possibilities. It deserves, at any rate, more consideration than it has received in the past.

The most neglected part is the medium for conveyance of the lubricant. Nobody will tell why it is neglected, but everybody will tell you its faults, even to including things that are not its fault. All of which improves the material not at all.

Whether every railroad has different ideas, or any ideas, of what exactly the best medium should be, is somewhat uncertain. What is certain is that each railroad favors a different preparation, and since they not only favor it, but use it extensively in actual service, they must feel that their particular preparation is right. Some of them may be right, but they cannot all be right when they are so different.

While there are those who believe that such variation is all wrong and that one standard preparation should be used, it is perhaps as well that some difference exists in the grade of journal packing used by railroads. There are substantial reasons for doubting that the same identical grade for all roads would be of any great advantage.

The subject of interchange is too frequently brought into the matter as an example of why things cannot be done. One hears plenty about what can't be done, but not so much about what might be done. The way to avoid the complications of interchange journal-box packing is not to have car journals packed by foreign roads. This, of course, is impossible, but it is not impossible to keep the packing of journal boxes by foreign roads at a minimum, and this is the next best thing. To keep this at a minimum, pack your own car journal boxes at the end of the required period whenever possible, and use a grade of packing waste that insures operation for this period or longer. The longer the better and anything that can be done towards this end is a step in the right diretcion.

If you pay for a good grade of packing you certainly want to know that you get it. There is only one way to do this. State definitely what you want and then see to it that what you get meets the requirements. It is easy enough to make statements of what you think you want, but it is not so easy to determine that what you get is what you need.

The trouble with specifications of railroad car-journal packing is that they require everything, and provide for the verification of nearly nothing. There is a wide and complicated variation of textile yarns. The selection and machining of a profitable journal packing at competitive prices is an art. Most of the artists have been long in their careers. The business of a railroad is transportation, not the manipulation of textile yarn. To specify in journal packing what can be definitely ascertained as required for efficient transportation is one thing, but to presume to regulate the refinements of an art with which one is neither familiar nor concerned, is only a waste of time and effort.

The Four Essentials

There are but four things of interest to a railroad in the qualifications of a good car-journal packing. They are purity, durability, oil absorption and resiliency. On these four points rests the efficiency of the medium for conveyance of oil to the bearing surface.

Upon these four points a railroad should concentrate its efforts, for on these and these alone are the standard and specification of quality for journal packing founded. The adoption of a standard based on these points, and the verification of it, is the concern of the railroad. With what materials, and by what means the required standard is produced, is no concern of theirs. That is the problem of the packing manufacturer.

By purity of journal packing is meant freedom from foreign substances which are likely to be injurious or interfere with a free flow of oil to the bearing surface. This includes metallic substances, straw, paper, wood, water, grease, or mineral abrasive matter. Most foreign substances are fairly well removed from the waste in the process of machining. All textile yarn contains a certain amount of water, grease and dirt. A small amount cannot be helped and must be tolerated, but when buying textile yarn you surely do not want to pay for any more water, grease and dirt than is necessary. Accurate methods for the determination of water, grease and dirt have been developed, and control of these constituents presents no difficulty.

The durability of journal packing concerns its ability to resist the destructive forces of service. It involves physical qualities of the threads, their strength and resistance to wear, and has to do with a considerable part of the packing and repacking costs.

If one has plenty of cash, and time is of no value, one can buy a nice looking cheap suit and throw it away when it soon begins to look shabby. A railroad can do the same with packing waste—the only difference is the scarcity and greater value of time, and the larger amount of ready cash required. Perhaps you would not buy shoddy suits, but perhaps you do buy shoddy packing waste. How do you know you do not? You certainly cannot rely on any present railroad specification. Some specifications actually specify material known to be of questionable durability. Have you ever seen anything in any journal packing specification that provides proper protection against the nondurable? Yes. Something to this effect: "The use of reworked threads or muck yarn is prohibited. Waste shall consist of new threads the product of looms, etc., etc."

Is this proper protection against the nondurable? It certainly is not. How can one tell from this whether a thread is reworked, made of muck yarn, new or not new, without taking somebody's word for it? True, if the thread appears to be weak, you can call it old, but you are only guessing. We are attempting to secure

packing that will give the longest service in the journal box at the lowest cost, and you can't do that by guessing.

The supposed protecting provision is too indefinite. It discriminates by name with no means for proof that the material is of the name. Why bother with names at all in a specification. We are concerned not with names but with durability. The thing to specify is a quality that will insure durability regardless of the name.

How to provide in a specification for a definite quality that will insure the receipt of durable packing waste is a problem for research. Perhaps it can be done by direct or by indirect means, or a combination of the two. Something better for the purpose is surely possible, but as far as known no railroad has in this matter ever attempted to find anything.

The importance of thread length is not so much what they are as laid in the mix, but what they are when mixed in the journal box. It is not the precise length of a few threads, but the general length of all the threads that is of significance. Suppose a waste contained no threads under 6 in. long, and no threads over 9 in. long. It would meet the requirements of any journal-packing specification, but not the requirements of a good journal packing.

Materials which do not absorb oil are of no value in conveyance of the lubricant to the bearing surface. There is a considerable difference in the oil absorption of the various substances used in packing waste. Some materials absorb oil very slowly, if at all. Others take up oil quite rapidly and release it nearly as fast. Much depends on the nature of the substance or the artificial characteristics imparted to it by some manufacturing process. Tightly spun threads for instance, will not have the absorption of threads loosely spun. Hard slasher threads do not have the absorbing power of soft spooler. Wool yarn may absorb oil slower than some cotton yarns, but once the oil is absorbed the wool retains it better.

The ideal material for the purpose will absorb the oil rapidly and release it slowly. Under such ideal conditions there is always lubricant present in the threads to be extracted by the revolving journal. What is this material or combination of materials that comes nearest to the production of the ideal? There are numerous opinions with little that is substantial for their support. The usual method of determining the oil absorption is not entirely satisfactory. Refinements in the method are needed.

One of the most important characteristics of journal packing is resiliency. All the purity, durability, and oil absorption, is of little value if the packing lacks in resilient qualities. It is the resiliency, and the resiliency only, that insures contact of the packing with the journal surface, and without this contact, there can be no conveyance of the lubricant to the bearing surface.

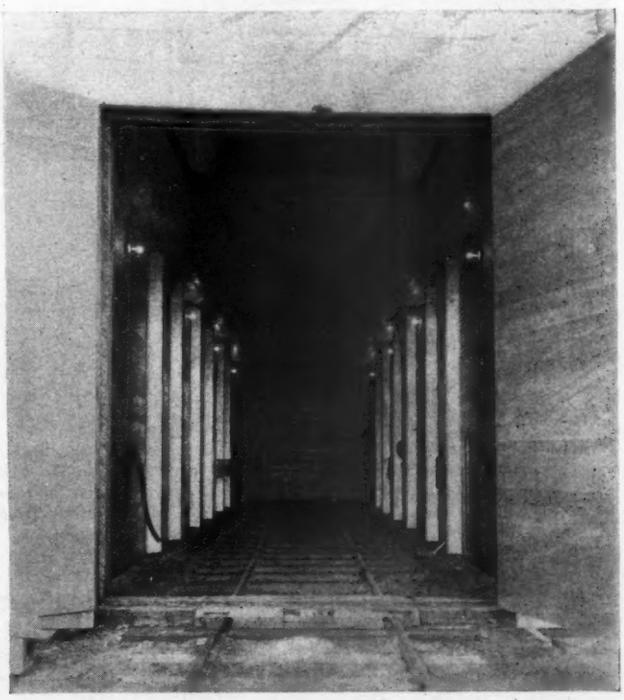
How much resiliency is needed? How can we know that we get it? Nothing but the proper kind of investigation will ever answer these questions.

Let each railroad work out these problems of journal-waste specifications for their own conditions of operation and costs. Some will see the advantage of improvements in the present standard journal-lubricating system and realize the value of efficient uniform packing. It has a part in reducing cost of hot boxes, necessity for jacking and repacking, and effects a saving by a greater yield of better reclaimed packing.

Whether or not these problems can be successfully solved remains to be seen. A more satisfactory specification for journal packing is most certainly needed, but before such a specification can be written, it will first be necessary to learn what to write. This will mean a certain amount of research, requiring both time and expense, but offering the prospects of a specification based, not on intangible terms assumed to provide for the proper material, but upon definite qualities which are desirable in packing for the efficient conveyance of the lubricant to the journal and the bearing surface.

Insulated Building for Testing Refrigerator Cars

The Fruit Growers Express Company recently completed the construction of an insulated building at Alexandria, Va., covering a standard-gage railroad track, in which refrigerator cars can be placed for testing under heat or cold. A short section of the track, passing through the entrance doors, is removable. After a car is placed in the building for test, the removable portion of the track is lifted out and replaced with an insulated block that completely fills the vacant space. The edges of the entrance doors have rabbitted stiles, thresholds and headers, all edges being insulated with special rubber gaskets to insure tight joints.



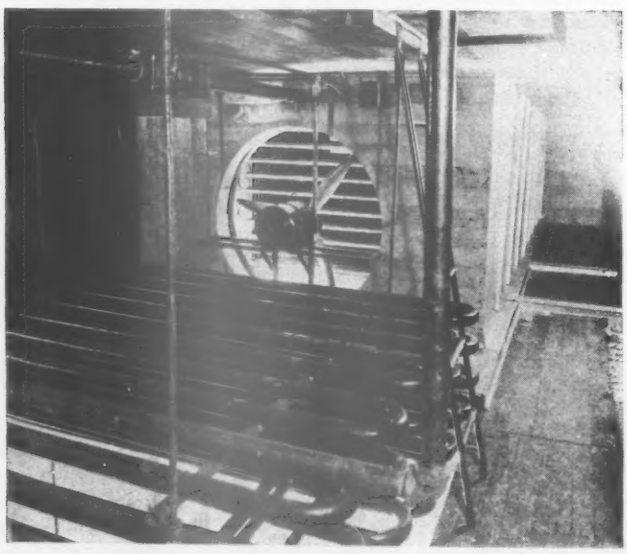
Interior of the test room showing doors open with track block section at end of building under door in place

The test room has an inside clear length of 58 ft., clear width of 16 ft. and clear height of 15 ft. Any present-day refrigerator car can be placed in it for testing. The building is of wood construction with steel reinforcements for supporting fans, motors, coils, etc., which are provided for heating or cooling the room as desired. The sides, ends and ceiling have 8 in. of efficient insulation; the floor contains cinder fill. The exterior of the sides, ends and roof are covered with asbestos wall and roof shingles. The building is provided with equipment that will produce air temperatures from —10 deg. F. to 150 deg. F. as desired within approximately five hours after the machinery is started. The test house is located adjacent to an ice manufacturing plant from which steam for heating and refrigerant

for cooling the building is furnished by direct connections.

The building was designed and equipped to develop and maintain positive known temperatures required to conduct tests of various kinds for the purpose of developing improvements in perishable protective service. By its use the efficiency of refrigerator cars of different construction, new types of material, new forms of insulation, and improved devices purporting to give more efficient results in icing and heating cars may be thoroughly tested for the purpose of determining efficiency and desirability of use.

The building is provided with a chamber adjacent to the test room for housing test instruments and taking temperature records. The temperatures of the car under test and the test room may be taken at will with electric resistance thermometers from leads passing from the



Interior view taken on the floor above the test chamber—The heater coils are shown in the foreground, between which light from the test chamber below can be seen—The 48-in. three-blade blower fan can be seen mounted in a partition, forming the end of the refrigerating coil duct, the pipes of which can be seen back of the fan

side of the building into the adjacent chamber through an insulated opening without entering the car or test room.

A test of the resistance of the insulated walls of the building to the transfer of heat was made by placing maximum-minimum thermometers in the building and keeping it closed for a two-week period with the refrigerating and heating equipment idle. The outside temperature during this test fluctuated from 20 deg. F. to 59 deg. F., a range of 39 deg. F., while the temperature in the building remained between 37 and 44 deg. F., a range of only 7 deg. F. On one occasion when the room was under refrigeration, the room temperature was held substantially between —8 deg. F. and —12 deg. F., for approximately six days. On another occasion, while the building was being heated, the room temperature was held substantially between 93 deg. F. and 97 deg. F. for nine days. The outside temperature during these tests ranged from 33 deg. F. to 70 deg. F.

The refrigerating and heating units were supplied by the Frick Company, Waynesboro, Pa. The temperature control is operated by hand valves when the building is under heat, but it is controlled by thermostats when under refrigeration. The refrigerating unit consists of 2,500 sq. ft. of cooling surface. The heating unit consists of 385 ft. of 2 in. heater pipe in a compact coil. Two direct-driven 48-in. Meier Nuair fans, each having a capacity of 20,000 cu. ft. of air per min., are located adjacent to the coils. When in operation they force air rapidly over and through the coils, circulating the driven air to all parts of the room through ducts provided for that purpose. The total space in the building is 20,764 cu. ft., less the space occupied by the coils, fans, machinery, deck and car under test. As the capacity of the fans is 40,000 cu. ft. per minute it will be seen that several changes of air per minute can be effected.

Unique Sketching and Drawing Board

The illustration shows a light-weight Bakelite drawing board which has the unique feature of permitting the user to make accurate drawings and sketches without the aid of a T-square. The board is designed with squared edges, which form the border of the board, and with spring paper clamps in the slotted corners. The spring clamps are so shaped that they elevate the corners of the triangle above the squared sides, thus permitting free movement of the triangle beyond the limits of the board. Therefore, with only the aid of a set of triangles all vertical, horizontal, and angular lines can be drawn. The paper is held on the board with the corner spring clamps, the tension of which can be relieved for removing the paper by means of finger

Board for making sketches and drawings without the aid of a T-square

pressure on small buttons provided on the back of the board. The drawing boards are made accurately within reasonable limits, and accurate drawings can be made with them if accurate triangles are used.

The drawing boards are made to accommodate 8½ by 11-in. letter-size paper, 9 by 12-in. standard-size drawing paper, or 10 by 15-in. patent-size drawing paper; the dimensions of the boards are approximately 2-in. longer and wider than the paper each accommodates. Other sizes however are made to order by the manufacturer, H. E. Towmley, Riverside, Calif.

SWITCHMAN—ARTIST.—John Adams, switchman for the Southern Pacific at Roseville, Cal., is also an artist, the only one of his kind in the world. Adams makes sand pictures in bottles, using a wide variety of colored sand and achieving some remarkable effects. So unusual is his hobby that it has been recorded in the movie series "Strange As It Seems."

EDITORIALS

To Boiler-Shop Supervisors

With this issue the *Railway Mechanical Engineer* resumes attention to the problems of the locomotive boiler shop and locomotive boiler maintenance which it relinquished to the Boiler Maker and Plate Fabricator when that publication became a member of the Simmons-Boardman family in 1919. The *Railway Mechanical Engineer* will endeavor to give the same attention to the boiler shop and to the problems of boiler design and construction that it does to the problems of locomotive design and construction, maintenance and repairs of interest to supervisors in the machine shop, erecting shop and other locomotive shop departments now dealt with in leading articles as well as in the Back Shop and Enginehouse department.

We shall endeavor to merit the good will of railway boiler-shop supervisors and shall welcome their criticisms and suggestions.

Apprentice Training Abroad

Several innovations in the apprentice-training system of the Victorian State Railways, which is described on another page, will be of interest to our readers on this continent. The Victorian Railways are quite deliberately planning to furnish an ample supply of thoroughly trained workers to meet future requirements. From these young men, as they go through their course, selections are made of those whose abilities and personalities promise to fit them for higher positions.

Among the unusual features are special compensation for boys from the country districts who must live away from home while they are learning the trade, scholarships for those who excel in order that they may secure a college training, and organized inspection visits to industrial and railway plants in adjacent states by those who measure up to certain qualifications. Finally, the graduate apprentices are encouraged to travel abroad to widen their observations and experiences.

The Victorian Railways, like those in this country, were forced to minimize their apprentice training activities during the depression. Now that that is behind them, they are approaching the problem with renewed vigor. Some railroads in this country are beginning to take a more active interest in apprentice training, but unfortunately are not showing nearly the same initiative as are those in charge of the Victorian State Railways. Both industry and the railroads today are seriously embarrassed because of the shortage of skilled labor. Thousands upon thousands of people who are now on relief, could be rendering worthwhile service if they had been trained for some trade or specific vocation.

The Victorian Railways apparently aim to train a large enough number of workers to supply their own needs and leave an oversupply of trained workers who can enter other industries. The Victorian Railways are government owned, but what a wonderful thing it would be for the American railways if they could not only take care of their own requirements, but could help to supply industry in general with well-trained workers. Surely there would be a far more sympathetic attitude on the part of industry toward the railroads and the difficulties they find themselves in because of over-regulation as compared with competing types of common carriers, which are in fact partially subsidized.

There have been times in the past when a few American railroads have set the pace in introducing modern apprenticeship methods. They were well paid for their efforts in improved and more efficient production; moreover, some of these men who graduated into industry have been among the strongest and most intelligent champions of the railroads in their fight to improve their condition and to maintain themselves as the backbone of American transport.

In Days When Machines Were Young

Some years ago when a certain large mid-western locomotive shop was first opened, a double back-geared lathe was installed, along with other machinery. Naturally it was a busy time for everyone, breaking in new machine tools and a lot of new men, while at the same time scheduling an output.

As the machine-shop foreman was instructing a new man how to operate a Morton draw-cut cylinder planer, and incidently trying to teach himself about it, he felt a tap on the shoulder from "Scotty" McDonald who had that morning started to work on the double back-geared lathe, and the following conversation took place:

"Well! What is it?"

"There's a tooth bruk on the gear of yon lathe."

"Well, too bad, but get busy. You can peg it yourself can't you?"

"Yus zir, I ken, but the gear that runs into it bruk as well; there's twa teeth outa thet and one of the gear arms is cracked too."

"Go and get Tommy Bell, the maintenance foreman, to send a man out to help you, and both of you keep busy. Got to have that lathe going tomorrow morning. I'm too busy to go with you."

"There's naw use sir, the twa arms that has the

bearins cast solid to the lathe heed and the gear that runs in them is bruk as weel—the whole G--D mess is leein on the flure you see."

"Oh well! Guess I'd better go and have a look at it myself."

Sure enough, the foreman found one tooth out of one of the gears all right, but the bearing arms and all the other gears were in just the sort of a mess "Scotty" described. He only wanted to break the news as gently as possible.

The days are largely past when gear teeth and other parts of modern machine tools break, although it is a fact that many a machine with a cracked base, welded head, or patched-up gear drive is still being nursed along in railway shops to the great detriment of output, not to mention the foremen's peace of mind. New tools, utilizing the modern advances in metallurgy and the long experience of specialized designers break only under the most unusual circumstances and have production capacities, using the best of modern cutting tools, of 10 to 1 as compared to some of the older tools.

Shop Men Should Know Material Costs

Locomotive and car maintenance costs usually constitute 60 per cent labor and 40 per cent material, although the 60-40 ratio varies considerably on individual jobs. This means that the primary emphasis in railway locomotive shops, car shops, engine terminals and car-repair tracks should be on the installation of labor-saving machinery, equipment, tools and methods. Of hardly less importance, however, are the possible economies through conservation of materials.

There is really a woeful ignorance on the part of many workmen and supervisors of the cost of materials and parts in everyday use in the repair shops. Take commodities, for example, such as glass, paint brushes, nuts, monkey wrenches, files, emery cloth, machine oil, waste, Stillson wrenches, pipe fittings, rivets, bar iron, steel billets, etc., and ask the first six men who are continually using them, and not one can give even the approximate price of any of these items. Shop foremen are often little better informed. Some will not even hazard a guess, and most of those who do are generally far and away too low in their estimates.

The inescapable conclusion is that, not knowing material costs, shop men and even foremen, in general, do not fully appreciate the necessity of using materials efficiently and with the greatest care and avoiding every possible wastage. Some roads have taken effective means to acquaint shop men with detail material costs, and responsible mechanical-department officers should constantly urge the wider dissemination of information of this character.

Car Department Officers Meeting

During the year 1935 Class I steam railways, excluding switching and terminal companies, expended $144,676,000 for repairs to freight-train cars; $51,302,000 was expended for repairs to passenger-train cars. This does not, of course, by any means measure the total expenditures made under the direction of the car department. It has other functions to perform and several thousand new freight cars were also built in railroad company shops.

Obviously there are great possibilities for savings where such large expenditures are involved, through providing the best type of supervision and by taking advantage of every possible improvement in administering the various details involved in the design, construction and maintenance of car equipment. Beyond this, however, the mechanical and car-department officers can be extremely important factors in increasing the business of the railroads, through providing and maintaining equipment which will make competition with other types of carriers more effective. Car-department officers, if they are to make the best of their opportunities, must take advantage of every possible opportunity to find the best solution for these problems and most effectively administer their departments.

Today the Mechanical Division of the Association of American Railroads is concerned with matters relating to the design of car equipment and the establishment and maintenance of standards and recommended practices. The latter include the numerous and complicated problems relating to the interchange of equipment. Beyond these, however, there are many other important aspects of car department operations which receive little or no attention from it. There is, therefore, a large place for an organization of car-department officers, which will investigate, study and discuss problems relating to the best methods and practices for maintaining and rebuilding car equipment. This would include a study of the machinery and equipment for repairing the cars, and the best arrangements and the most efficient methods of operating car repair shops and yards.

The most important factor in any organization is the human element. It is true that industry has given much study and attention to the best methods of dealing with the worker and to directing his energies, and yet, unfortunately, the problem of training and educating workers and of dealing with them, so that they may become a loyal and effective group, has not received much special attention in the mechanical department, and particularly in the car section. It would seem, therefore, to be of special importance that the car-department officers should organize effectively to study these problems and to compare methods and practices, in order that the whole standard of operation of the car department should be raised to the highest possible level.

The Car Department Officers' Association, like most of the other minor mechanical-department organizations, was forced largely to discontinue its activities during the depression years. Its officers, however, are not asleep to the opportunities which lie before it and are now working actively and aggressively to develop a program for the meeting which is scheduled at Chicago, September 21 and 22. There are such tremendous possibilities in having it function efficiently in the interests of improved railway operation, that no stone should be left unturned to make this meeting a big success and to re-establish the work of this association on a sound and substantial basis.

There are other ways, of course, in which it can be helpful. The Mechanical Division has been looking to the various car foremen's and car inspectors' groups scattered throughout the country for facts and suggestions which will help to improve the interchange rules. The Car Department Officers' Association has also had a part in this work, but because of its personnel, might well function more effectively in these matters before they are finally acted upon by the Mechanical Division. Be that as it may, there is an important place for the Car Department Officers' Association, even if it does not function at all in this respect, although it is understood it will give considerable attention to interchange matters at its meeting in September.

Do Modern Machine Tools Really Pay?

The question as to whether the installation of modern machine tools in a railroad shop really pays is one that is difficult to answer without an accurate analysis of the conditions under which they are to be used. The relative lack of detailed information concerning machine-tool use in railroad repair shops as compared to many industrial plants makes it seem at times that the railroad man is not particularly interested in detailed costs. It is therefore highly encouraging to find that most roads, faced as they are with the necessity of expanding shop operations, are now giving serious consideration to programs of machine-shop rehabilitation that will enable them to cut the cost of machining locomotive parts.

More encouraging is the fact that the roads which have purchased a number of new tools over the past year or two have done so only after the most careful analysis of present methods and costs. The new tools that are now producing substantial savings are able to do so because they were purchased to do a specific job and expected to develop specific results.

One Eastern railroad, about a year ago, requested a manufacturer of turret lathes to have one of his engineers, experienced in production work, make a detailed study of all of the turret-lathe work in a certain department of the road's principal repair shop with the result that, where thirteen machines, most of which were over 20 years old, were formerly being used, six new machines of modern design are now being installed to handle an increased volume of work. Here is evidence of the faith of a mechanical officer that modern machines do pay.

In another case a railroad, after careful analysis back in 1935, had estimated that it could install approximately 30 machine tools to replace obsolete equipment and pay for the new machines in from four to five years out of savings if they could be operated on an average of 16 hours a day. How nearly this has been accomplished is told in a report on the performance of this equipment furnished by that road within the past two weeks. The new machines have now been in operation approximately 18 months and, at the end of April, 1937, had accumulated savings of 25.8 per cent on the original investment in spite of the fact that business conditions during that time had made it impossible for the tools to be kept busy more than from 34 to 47 per cent of the time. During the past twelve months these machines have saved 22.9 per cent on the investment; in one month of the twelve the savings attained were at the yearly rate of 26 per cent and in three of the twelve the savings exceeded that yearly rate. Two things stand out in this record of performance: First, that the economics of actual service have been eminently satisfactory in spite of the fact the machines have been used less than half of the anticipated time and, second, that the actual results have justified the time spent in making a thorough analysis of previous methods and costs. Here, at least, is one road with sufficient evidence in its own records to answer affirmatively and emphatically the question, "Do Modern Machine Tools Really Pay?"

NEW BOOKS

ENGINEERING REPORT ON AIR CONDITIONING OF RAILROAD PASSENGER CARS. *Prepared by the Division of Equipment Research, Association of American Railroads, 59 East Van Buren street, Chicago. 316 pages. Price to member roads of A. A. R., $1.50; to others, $3.*

The Summary Report on air-conditioning issued on November 24, 1936, dealt with those factors of air-conditioning railroad passenger cars of direct concern to the railroad executive. The Engineering Report, the second of the series, is designed to meet the needs of the air-conditioning engineer and railroad operating personnel. In it the results of laboratory tests and of road performance tests of cars are presented in four parts: Part I—Tests of Air-Conditioning Systems; Part II—Tests of Drive Mechanisms; Part III—Hot-Room Tests of Air-Conditioned Cars, and Part IV—Road Performance of Air-Conditioned Cars. The subject of costs is not dealt with in the Engineering Report but is discussed in detail in Part V of the Summary Report.

THE READER'S PAGE

Some Answers To the Valve Problem

To the Editor:

The tough valve problem on page 221 of the May issue does not appear to be so hard to solve. I made a drawing to a scale of ⅛ in. to the foot and found that all parts of the gear were within and not exceeding the allowed angles from the crank up to the combination lever. I believe that with the proper setting the compression kick can be stopped.

The 18 9/16-in. eccentric crank with a 20 1/16-in. throw will give a constant lead. An eccentric-crank throw of 21⅝-in. with an 18 9/16-in. crank will delay the cut-off if the crank is moved out after the cut-off has been checked with a throw of 20 1/16 in., because the valve travel will be longer. This will also increase the lead in the corner and up to the center. If the crank is moved out, this would delay the cut-off to about 30 per cent; to get a cut-off of 25 per cent the reverse lever would have to be hooked up about one notch closer to center. In other words, increasing the lead hastens all valve events so that point of preadmission occurs earlier, cut-off is earlier, release is earlier, closure occurs earlier, the admission period is unchanged, expansion begins earlier but the period is unchanged, compression is earlier with the period unchanged, and exhaust earlier with its period unchanged. It would be better to change the combination lever and let the crank stay at 20 1/16 in.

C. J. McCready.

Is This the Solution?

To the Editor:

When reading the valve-gear problem of K. B. G. in the May issue one or two points occurred to me. The lap, lead, exhaust clearance and full-gear travel given, are exactly as for the C. M. St. P. & P. 4-4-2 high-speed engines described in the June, 1935, issue of the *Railway Mechanical Engineer*. One would hesitate to criticize these characteristics, as we presume the Hiawatha locomotives can be operated at 25 per cent cut-off, but inquiries on this might prove interesting. On the other hand, the clearance volumes as a percentage of the piston displacements will differ and the 27-in. cylinders will have more clearance than the 19-in. cylinders of the Milwaukee engines. I believe the 27-in. engines have not enough compression at 25 per cent cut-off.*

I would suggest altering the lap-and-lead levers to give ¼ in. lead and 1½ in. lap and set line-and-line on the exhaust edges or, alternatively, try not more than 1/16 in. exhaust clearance. This might give the results required. In any case, with about 10 or 12 per cent clearance, not less than 30 per cent compression (i.e., closure at 70 per cent) will be wanted at 25 per cent cut-off and the exhaust clearance can be adjusted to get this result.

Adding to the lap will, of course, shorten the full-gear cut-off, but that will be an advantage, for one reason, because it will allow of a proper exhausting of the steam in full gear with the proposed reduced exhaust clearance. At present the release is too early when running at short cut-offs, but the excessive exhaust clearance is required in order to get the steam out of the cylinders with the long cut-off in full gear.

K. B. G. should refer to the *Railway Mechanical Engineer* for January, February and March, 1933, for remarks on lead variation in the Walschaert motion. There are two or three methods of accomplishing this and all have been described in your paper. Variable and increasing lead as the cut-off is reduced is an advantage, but the thing to do in the present case is to get more lap on the valves and increase the compression, not reduce it. The engines will then run 20 per cent, but 25 per cent will be the best position for all-around good results.

E. Cecil Poultney,
London, England.

Large Heating Surfaces

To the Editor:

On your Gleanings page a correspondent brings up the question of large heating surfaces in the boilers of 4-8-4 type locomotives. On referring to page 45 of your February, 1936, number, I note that the Chesapeake & Ohio Class J-3 locomotives are said to have the "largest combined heating surface of any locomotive of this type thus far built; namely, 7,880 sq. ft." Your correspondent also believes that the C. M. St. P. & P. Class S-1 locomotive, with 7,803 sq. ft., should occupy second place.

In making these statements, two other locomotives seem to have been overlooked. The A. T. & S. F. locomotives of Class 3751, which were described in your July, 1928, number, have a combined heating surface of 8,098 sq. ft., and in the Great Northern Class S-1 engines, this figure reaches 7,849 sq. ft. Because of the difficulty of keeping track of these "records," I would not claim that the Santa Fe engines should head the list, as the next number of the *Railway Mechanical Engineer* might possibly describe something even more imposing.

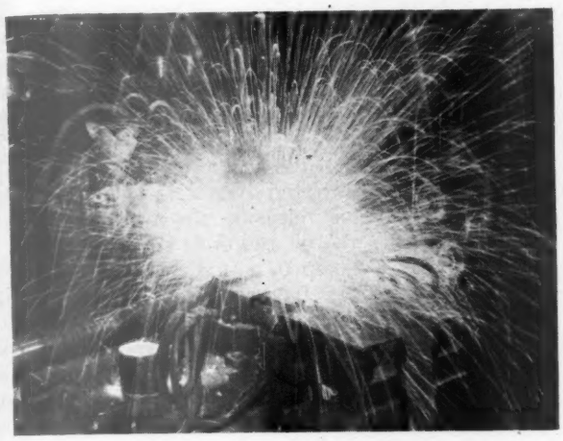
While on the subject, it might be of interest to mention that the Class T-2, 4-8-2 type locomotive, built for the Baltimore & Ohio in 1931, has a combined heating surface of 7,957 sq. ft., though it weighs nearly 50,000 lb. less than the lightest of the engines previously mentioned.

It is hardly necessary to add that too much importance should not be attached to differences of one or two hundred square feet of total heating surface in these large boilers, since many other factors must be considered before any intelligent prediction and comparison of their performance can be made.

William T. Hoecker.

* See the *Railway Mechanical Engineer*, November, 1934, page 405.

IN THE BACK SHOP AND ENGINEHOUSE

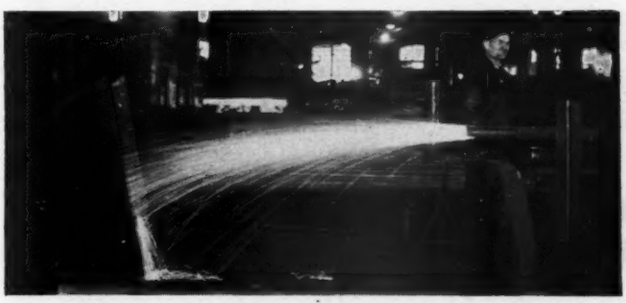


During the flash period air is blasted through the flue.

Safe Ending Flues Improved by Air Blast

The troublesome ridge on the inside circumference of boiler flues and tubes, formed by rolling-in the slag from the resistance butt welds of safe-ended flues when working the hot weld over a mandrel between a set of rolls, has been eliminated successfully at the West Albany shops of the New York Central System by the simple expedient of blowing the slag from the resistance weld by a blast of air during the flash period. Prior to incorporating the air-blast innovation with the resistance welder, the rolling-in of the slag on superheater flues formed a ridge approximately $\frac{3}{8}$ in. long and $\frac{3}{32}$ in. high, thereby reducing the inside diameter of the flue at the weld by about $\frac{3}{16}$ in. This reduction in diameter was found objectionable because the bands on superheater units caught on the ridge when the units were applied and because it restricted the flow of hot gases, increased the scoring effect of cinders, and afforded a starting point for the honeycombing of cinders. One of the illustrations shows the effectiveness of this air blast in eliminating the ridge; the view showing the ridge formed by rolling-in the slag was taken of a flue which had been in service several years.

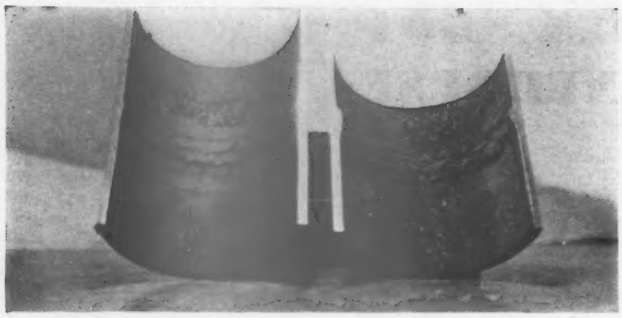
When welding safe ends to old flues at the West Albany shops, the safe end and one end of the flue are held in water-cooled copper electrodes, and as the two are forced together, a heavy a.c. current is passed between them. During the flash period which occurs when the two ends are brought together, air is blasted through the tube under manual control of a foot valve. When the flash is over the air is shut off and two ends are brought up to a welding heat. As soon as sufficient heat has been applied, the flue is moved forward over a mandrel and between a set of rolls where the hot weld is worked and reduced in section. The blast of air furnished during the flash period comes from a short piece of $\frac{3}{8}$-in. pipe threaded into a hole in the end of the mandrel and terminated with a nozzle in which there are six small holes. Air pressure at 80 lb. per sq. in. is applied to the inside of the mandrel during the flash period, and the air is ejected through the holes in the nozzle, the holes being so drilled that the air is forced outward at an angle of 30 deg. with the horizontal, thereby imparting a spiral or rotating motion to the air as it passes through the flue. The hot slag at the inner surface of the weld is carreid away and blown out of the end of the flue into a receptacle placed to receive it. When the weld is rolled, there is very little slag inclusion and therefore no ridge formation or decrease of flue diameter. The quality of the weld is also improved.



Slag being blown from the flue during the flash period

When flues have reached the limit of safe ends which can be applied, it is general practice on the New York Central to cut off all the welds, weld on a length of second-hand flue, and then apply a 6-in. safe end of new material. At the next shopping the 6-in. end is cut

Left: The welding electrodes and rolls—The air nozzle can be seen extending from the mandrel—Center: The air nozzle—Right: The welded flue is pushed forward over the mandrel and rolled



Left: Superheater flue rolled after slag has been blown from the safe-end weld—Right: A flue with slag inclusions rolled into the weld which reduced the inside flue diameter 3/16 in.

off and an 8-in. safe end is applied. At the third shopping the 8-in. end is cut off and a 10-in. safe end is applied. At the fourth shopping the 10-in. end is cut off and 12-in. safe end is applied; the 12-in. safe end is the maximum length of new material used. At the fifth shopping an 18-in. length is cut from the flues, and a 12-in. length of second-hand flue plus a 6-in. safe end are welded to the flue to restore it to its required length. This procedure is followed indefinitely. If a flue is pitted, the pitted portion is cut off and a section of second-hand flue plus a 6-in. safe end are applied to restore the flue to its required length. The mandrel over which the flues are rolled is 10 ft. long to accommodate long pieces of second-hand flues which must be applied when reclaiming flues.

There is one resistance welder for superheater flues and one for tubes in the West Albany shops with nominal ratings of 165 to 150 kv.a., respectively. They operate from a 440-volt 60-cycle circuit. All welding is done on the second trick for the purpose of reducing the peak load on the power plant.

Electric Furnace Used In Sedalia Spring Shop

One of the most modern applications of electric furnaces to railroad repair work is the installation in the spring shop in the Sedalia, Mo., shops of the Missouri Pacific. The electric furnace, used for heating springs of both the coil and bar type, was installed in December, 1935, and is of the bell-car type. In other words, a bell housing, operated up and down hydraulically, is placed over a specially constructed car carrying a basket containing the load of springs to be treated.

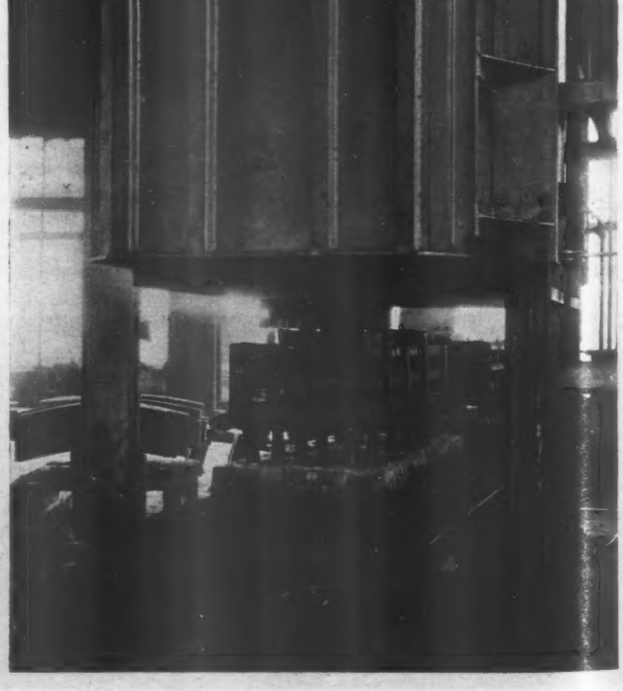
This furnace was designed and built by the General Electric Company. The overall dimensions of the bell are: Length, 8 ft., width, 4½ ft., and height, 7 ft. With the bell raised, the height above floor level is 12 ft. The inside dimensions are: Length, 72 in., width, 28 in., and height, 28 in. The shell of the bell is of steel, with 9 in. of silocell insulation, and semi-refractory brick lining. Heating units, of the nickel-chromium ribbon-resistive type, are mounted inside on the side walls and ends of the bell. An alloy-metal baffle is mounted inside the bell in front of the heating units. Two turbo-type blowers, 18 in. in diameter, are mounted in the top of the bell. These draw air up from the load, through openings in the top baffle, and distribute it behind the side and end baffles, over the heating units, and back to the base of the shell, where it is distributed through the load and drawn back up again.

Two narrow-gage cars are used in conjunction with the bell. When lowered over the car, the furnace rests in a sand seal, an angle iron on the furnace fitting into a sand filled channel on the car. A hearth is provided on each car, the load being supported on pedestals 7½ in. above the hearth.

Springs to be tempered are placed in specially constructed baskets approximately 72 in. by 22 in. by 20 in., made of 3/16-in. by ¾-in. wire-mesh screen mounted on a frame of ½-in. by 2-in. steel. A basket is placed on one of the cars by a 3-ton pneumatic jib crane located adjacent to the furnace, and then the car is pushed into place under the bell of the furnace. In order to place the car accurately, a bar lock is provided, fitting into an alining clamp attached to the framework supporting the bell. The bell is then lowered over the basket of springs by operation of a valve releasing the oil from the hydraulic lift back into the oil reservoir.

As the furnace heats up to a predetermined temperature, which may be any temperature up to 1,200 deg. F., the temperature is recorded continuously by a Leeds & Northrup recording instrument which, when the desired temperature is reached, cuts out the heating elements. Subsequently, the Leeds & Northrup instrument cuts the heating elements back in if the temperature drops more than 10 deg. below the predetermined desired value. Thus, the temperature in the furnace, which incidentally is maintained exceptionally uniform throughout the interior by the use of two blowers mounted on the top of the furnace and operated by two 3-hp. General Electric induction motors, is maintained within 10 deg. of the predetermined value. The temperature control is provided by a thermocouple inserted approximately 8 in. below the top of the furnace, and extending approximately 3 in. into the interior.

The bell is raised and lowered by operating a magnetic switch which controls the operation of a centrifugal



The electric furnace with bell raised showing load in place for heat treatment

The electric furnace with bell lowered in position on one of the cars. The blower motors can be seen at the top of the bell, while the hydraulic pump and its motor are shown to the right in the triangular structure

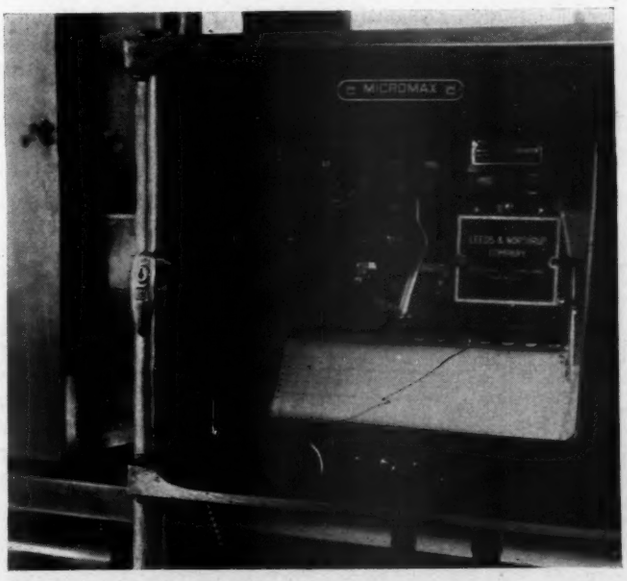
pump for pumping oil into a hydraulic lift. When the bell rises a limit switch cuts out the heating elements and stops the blower motors. A limit switch stops the bell when it reaches its maximum height. When the bell is lowered to a closed position, by releasing oil from the hydraulic lift, the limit switches to the heating elements and blowers are closed but are not energized until a magnetic push button is operated.

Among the advantages obtained from the use of the furnace are: Those arising from uniform furnace temperature, with only 10 degrees variation above or below that desired; improved quality, particularly where alloy steels are used, as is more common at the present time; and a saving of $615 per month on labor, fuel oil and material by substituting the electric furnace for an oil-fired furnace. The furnace uses 70 kw. per hr., at which rate the cost of operation is $3.15 per day or $69.30 a month, based on an average power cost of 1c per kw.-hr. and an average operating period of 4½ hrs. per day and 22 days per month.

Procedure in Treating Springs

The method of handling and processing springs is interesting in that material entering the shop at the east end follows through the shop from one operation to another, progressively, so that it emerges at the west end complete and ready for service. The spring shop is approximately 75 ft. wide by 150 ft. long. The storehouse for spring steel is just outside the east end of the spring shop. Steel for bar springs is taken from the storehouse through one of the spring-shop windows, and is cut into correct lengths, according to the class of spring desired, on a punch and shear machine driven by a Westinghouse 5-hp. motor. Some of the plates are punched, as necessary. The steel plates then go to an oil-fired center heater furnace, equipped with blowers driven by 3-hp. motors. Here the steel is heated to about 1,700 deg. F. preparatory to going to a "nibber," driven by a Westinghouse 5-hp. induction motor. The steel is again heated, in another oil-fired "forming furnace" equipped with a blower driven by a 7.5-hp. motor. In this furnace the steel is heated to approximately 1,800 deg. F., the temperature being controlled on this furnace by Leeds & Northrup thermocouple control equipment, without recording instruments.

After forming is completed in a pneumatically operated "former," the steel is air-cooled, after which it is placed in a rotary furnace, with an 11-ft. bed plate and an operating cycle of 40 min., for hardening. Carbon steel is heated to 1,525 deg. F. while alloy steel (silicon-manganese) is heated to 1,625 deg. F., for one cycle of 40 min. A Leeds & Northrup automatic temperature control, including a recorder, is used on this furnace. The furnace table is turned by a Westinghouse 3-hp. motor, chain connected; the cycle can be adjusted from 7 min. to 40 min. A blower on this furnace is operated

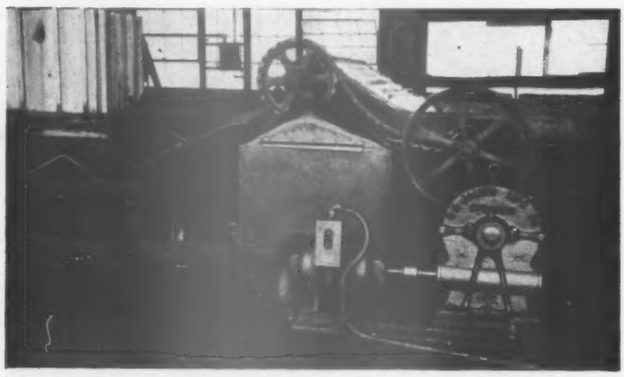


Leeds & Northrup temperature recorder used with the electric furnace

by a Westinghouse 5-hp. motor. Following the hardening heat treatment, the spring plates are quenched in a bath of E. F. Houghton's soluble No. 2 quenching oil. The oil is pumped into the bottom of the quenching vat at the bottom and runs out a weir at the other end at the top at the rate of 300 gal. per min., being pumped into the vat by a centrifugal pump operated by a General Electric 3-hp. induction motor. To keep the oil cool, it is conducted through a water-cooled cooler, by a centrif-

ugal pump which is started by a thermostat when the temperature of the oil goes above 140 deg. F.

As the spring plates are dumped into the oil vat they fall on a conveyor rack of the steel-chain type operated by a 2-hp. motor. The plates are in the quenching oil



Quenching vats with motor-driven air pump

for 3½ min. Following the quenching bath, the plates are placed in the baskets for temper treatment in the electric drawing furnace described previously. Carbon steel is drawn to 725 deg. F., while alloy steel is drawn to 925 deg. F., for 1 hr. 15 min. After this, the plates are air-cooled, and assembled ready for banding. An oil-fired band heating furnace is provided, equipped with a blower driven by a 2-hp. motor. The bands are heated to 1,800 deg. F. Hydraulic banders, exerting 1,500 lb. per sq. in. pressure are located adjacent to the doorway at the west end of the building. The pump supplying pressure for the banders is driven by a 20-hp. motor.

Coil springs are heated to 1,625 deg. F. for 40 min. in a separate rotary furnace on the north side of the building equipped with Leeds & Northrup temperature control equipment. The table and blower of this furnace are driven by 5-hp. motors. After being heated, the coils are placed in a coil former which is pneumatically operated, after which they are taken to a separate quenching vat, similar to the one described previously, and placed in the oil for 4 min. with the oil to 140 deg. F. or less. Both the coil-spring and leaf-spring vats are fed from the same source. Following this treatment the coil springs go to the electric drawing furnace.

A Tinius-Olsen hydraulic beam-type testing machine, situated in the northwest corner of the shop is used for testing both coil and elliptic springs, about six springs being selected from each class of springs passing through the shop. In addition, all springs are tested on the hydraulic testing machine for load-carrying capacity, free and loaded height, and checked for any possible defects before leaving the shop.

Typical Engineered Cleaning Operations

*By H. Liggett Gray**

The study of cleaning materials and methods of a railroad maintenance problem was taken up as a definite engineering project more than a score of years ago. The first step, logically, was to separate the project into two divisions—chemical and mechanical. (1) The chemistry of the cleaning problem includes the types of oils, greases and foreign matter to be removed and what types of cleaning agents were most active on these in order to produce fast-working, safe, economical materials. (2) The mechanics of the cleaning problem involves the development and refinement of the most effective methods of applying the cleaning materials.

Study By Types of Cleaning

Since cleaning operations differ so greatly, they have been classified and individual engineering study made of each type. For example, some cleaning operations are performed as a mechanical necessity in the operation of a railroad. Typical of these are cleaning locomotive mechanical parts for overhaul, periodical cleaning of air pumps and air-brake parts, and cleaning frames, driving

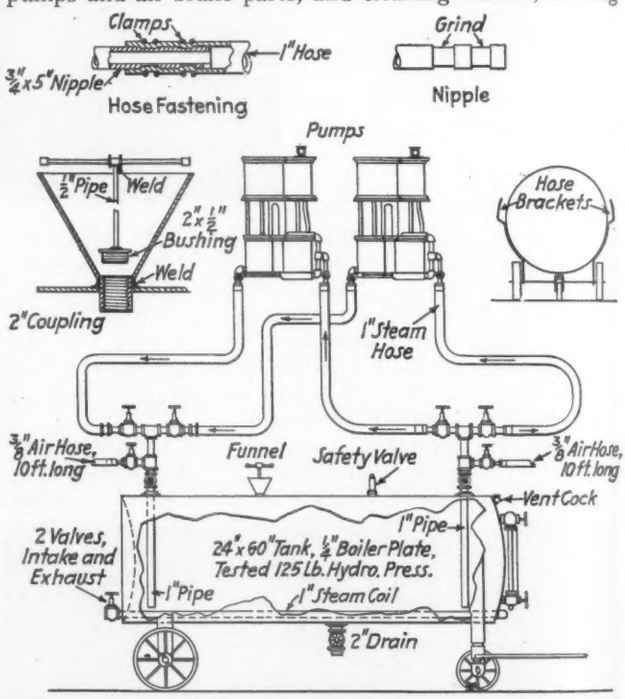


Fig. 1—Solid-flow circulation system for cleaning air cylinder, valves and ports of air pumps

rods and valve-gear parts preparatory to making fracture tests.

Other cleaning operations are done more for the sake of appearance or comfort. Typical of this classification of cleaning operations are the following: Cleaning of locomotive cabs and tenders, coaches and other cars, and the air filters and heating coils of air-conditioning systems.

Servicing of Air-Brake Equipment

The maintenance cleaning of braking equipment has necessarily kept pace with the constant improvement of the equipment itself. The parts which receive particular attention with respect to cleaning are air pumps, intercoolers, reservoirs, and triple valves.

In addition to cleaning the pumps, during shopping periods, it has been found advisable to adopt as standard practice the periodical cleaning of the air cylinders without removing the pumps from the locomotives. This keeps the valves, piston rings and ports free from gummy or partly carbonized lubricating oil. There are two very simple methods recommended for this work. One method circulates a solid flow of cleaning solution through the air cylinders; the second method, sometimes referred to as the "vapor system," permits the

* Assistant Manager, Oakite Products, Inc., New York.

pump to circulate a froth of bubbles of high cleaning ability.

Fig. 1 illustrates a simple arrangement of portable equipment required for the system employing solid-flow circulation. Such equipment is easily assembled in any railroad shop. The engineering details, however, as to connections, sizes of piping, etc., will be most effective if checked by a cleaning service man familiar with that work. In any event, it is essential to supply a tank with a safety valve, hoses, and connections, all designed for high pressure. The material, as well as the equipment, should be carefully selected not only so that it will remove the heavy oils but so that it will be safe for the men to handle, avoiding the danger to eyes and skin

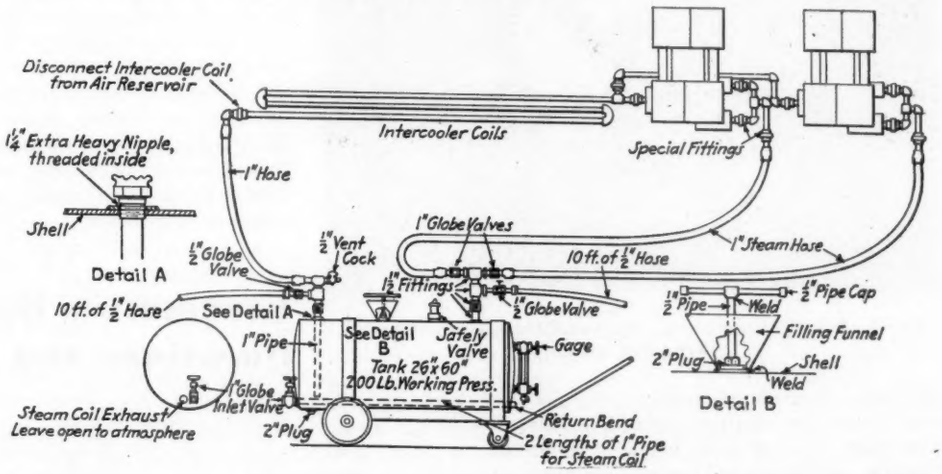


Fig. 2—System for circulating frothy cleaning vapor adaptable to cleaning air pumps, intercoolers and reservoirs

which are present in the use of caustic or lye. Cleaning the air pump with this equipment takes about one hour, including the time to make the necessary connections.

Fig. 2 illustrates a vapor system for cleaning air pumps which is fully as effective as the solid-flow system and has the added advantage that it can be applied at the same time to cleaning intercooler coils and, if necessary, air reservoirs. It has been found that inevitably a small quantity of excess oil occasionally is carried into the intercooler coils and even into the air reservoirs. Accumulations of such oil are dangerous for they can, under certain conditions, produce an explosive vapor causing a rupture of the air reservoir. Therefore, some railroads have found it advisable to apply this vapor system, with the circulation cleaning out the intercooler coils, as well as the air cylinders of the air pumps. This equipment is easily assembled at small expense from materials already available in practically any railroad shop, but it still is advisable that a cleaning service man cooperate in the initial installations to assist in obtaining the quick and thorough cleaning results which this material and method can produce.

Triple valves, distributing valves and other equipment auxiliary to the air-brake system can be cleaned in a tank of heavy-duty cleaning solution, heated by steam. It is generally recognized that this procedure saves labor in disassembling such equipment while making repairs and gives assurance of clean air passages.

Heavy braking caused by dirty brake equipment brings the train to an abrupt, uncomfortable stop and sometimes results in slid-flat wheels. As an illustration of the economy of modern cleaning methods, one railroad division which had thirty-five flat driver wheels during a two-year period before adopting modern cleaning materials and methods for air-brake maintenance had but one slid-flat driver in two years following the adoption of an engineered cleaning program.

Steam Cleaning Locomotive Gear

An example of another classification of cleaning work for railroads is the application of steam cleaning. This does not refer to the use of live-steam alone which, while it will knock off large pieces of dirt, will not remove grease and oil, particularly on parts which have been subjected to heat. Furthermore, such an operation is expensive since it will require more steam than a properly designed steam cleaning installation.

Several methods have been developed for combining a flow of heavy-duty cleaning solution and water, propelled by steam. These are not very complicated to install but the details have required much engineering work in order to proportion the various parts of the system properly so that they will operate with greater cleaning effect and at less cost than makeshift equipment.

Typical uses of such an installation are: (1) Service cleaning of locomotive running gear, (2) cleaning locomotive and car truck parts in the shops before overhaul, and (3) cleaning driving rods, cross heads, valve gear and frames before applying whitewash for fracture tests.

Fig. 3—Cleaning a locomotive with heavy-duty cleaning solution and water propelled by steam

Fig. 3 shows a typical installation in use for service cleaning of locomotives. The success of such cleaning depends both upon the cleaning material used and the mechanical arrangement of the installation. It can be assembled from parts generally found in the railroad

shop. The design of the actual steam gun which the operator handles has been thoroughly studied and is a more important item than might be realized. Fig. 4 shows an effective type of gun. Makeshift guns are likely to discharge alternate slugs of solution and steam or be so heavy or improperly balanced that the operator tires easily and does poor work. With a proper steam

Fig. 4—Properly balanced and heat-insulated gun for cleaning locomotive parts

gun and effective cleaning materials, one man can do more thorough cleaning of a locomotive frame in shorter time than several men, using a steam jet, scrapers and brushes, or other inadequate methods. Proper cleaning is of particular importance in preparing for fracture tests since whitewash applied to parts on which there remains even a small film of oil or other foreign matter, will sometimes prevent cracks in the metal from showing up.

Other Modern Cleaning Problems

The modernization and changing character of motive power and rolling stock has brought additional cleaning problems for which it has been necessary to develop special materials and methods. For example, any appreciable accumulation of deposits and foreign matter which gather in the cylinder jackets and radiators of internal-combustion engines is likely to cause over-heating at heavy loads. It has been necessary to develop materials which will remove the bulk of the scale and deposits in these cooling systems, at the same time providing for safety from attack to the cast-iron water jackets, gaskets, rubber hose, pump packings and various metals in the radiators. Such a material, properly applied, maintains an internal-combustion engine in good condition and saves a great amount of labor when compared to removing the deposits by hand. It also reaches and cleans out deposits in pockets which are almost impossible to reach when scraping out by hand.

A different class of cleaning problem has been encountered since the introduction of air-conditioning. The air filters must be cleaned at regular intervals so as to provide full capacity for the flow of air while retaining the ability to filter the impurities out of the air.

An additional cleaning problem is the maintenance of the bright-colored finishes which are used on a number of the modern high-speed trains. Even for such work, cleaning materials have been developed which will maintain the bright color and gloss of the paints without injury.

Safety, as well as economy, results from a well worked out cleaning program based upon experience. Such programs naturally differ widely with different railroads. Therefore, the schedule must be flexible until an experience record has indicated just what intervals of cleaning fit the particular situation. Almost every railroad differs from all others as to types and amounts of equipment, shop and yard facilities and types of foreign matter to be removed.

However, the handling of the problems in all instances is fundamentally the same, in that (1) materials and methods should be applied that are the most effective for each individual cleaning operation and (2) a time schedule should be set so that the cleaning operations can be carried out at the definite intervals which experience indicates are the most suitable.

The result of establishing such a program promotes safety to train personnel and traveling public from properly cleaned mechanical parts, permitting proper inspection and repair; safety to railroad shop personnel from use of safe cleaning materials and methods; safety to locomotives, rolling stock, and other equipment cleaned by materials non-injurious to the metals and parts, and prevention of accidents, mechanical failures and breakdowns by proper cleaning of mechanical parts, permitting effective inspection.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Soft and Hard Boiler Patches

Q.—Please explain the meaning of a soft patch and a hard patch on a boiler?—T. K.

A.—A soft patch is a patch put together by bolts or screw studs and usually is of a somewhat temporary nature. A hard patch is a patch secured by riveting and is a permanent repair.

Function of The Injector

Q.—An injector is feeding a boiler at 100 lb. per sq. in. steam pressure. Describe its action fully.—G. G.

A.—An injector forces water into the boiler because the kinetic energy of a jet of steam is much greater than that of a jet of water escaping under the same conditions.

A simple illustration of an elementary steam injector is shown in Fig. 1. Steam at 100 lb. per sq. in. pressure is admitted through the steam supply *A*, flows through the steam jet *C* and combining tube *D* and passes through overflow *G*. The action of the steam jet through *C* creates a vacuum in the feedwater inlet *B*. The vacuum created in the feedwater *B* draws in the water which, meeting the steam in the combining tube *D*, condenses the jet of steam. The steam issues from the overflow *G* as a jet of water, rapidly increasing in velocity, which builds up pressure against the boiler check *H*. The continued increase in velocity of the jet causes pressure against the boiler check to exceed the

boiler pressure of 100 lb. per sq. in. and the latter begins to open, part of the water entering the boiler and part flowing out through the overflow *G* until the velocity in the combining tube *D* has become so great that all resistance is overcome and the check valve *H* is forced wide open, all the water entering the boiler. The action of the jet passing from the combining tube *D* to the delivery tube *E* now creates a vacuum in the overflow, which causes the overflow to cease, closing the overflow tube, thus shutting out the air which would otherwise be forced into the boiler.

Stress Relieving in Boiler Welding

Q.—What is meant by stress relieving?—A. P.

A.—Stress relieving is the act of relieving the stresses set up in the metal of an object due to the expansion and contraction while being welded.

Fusion welding of boiler plate causes a high temperature to be applied locally in the sheet at the point of the weld. The molten metal of the weld is surrounded by the relatively cold mass of metal in the rest of the sheet. The consequent expansion and contraction result in the possibility of setting up more or less severe stresses in the weld or in the metal adjacent to it. Such stresses are referred to as "locked-up stresses." There is no question whatsoever that such stresses do exist. How severe they may be and what their distribution is have not been positively determined, but in many cases, and particularly in vessels of heavy plate thickness, steps must be taken to relieve such stresses if the vessel is to be safe for use.

Working Nickel Steel

Q.—Our railroad recently purchased some locomotives which use nickel steel in the boiler construction. I have read numerous articles but have not come across anything that gave me any information as to the proper method of working this particular steel.

I would like some information in regard to heating this metal, as in applying a patch, etc. The general opinion seems to be, to keep heat away from this metal as when fitting up a patch and getting it ready for riveting.—R. M.

A.—There is no objection to heating nickel steel, provided it is done properly. It is advisable in heating nickel steel, preparatory to working, that the temperature range from 500 degrees to 700 degrees F. be avoided. Uniform application of heat until the plate is cherry red should produce satisfactory results in forming the patch. When cooler or in the 500-degree to 700-degree F. range, the steel is "blue brittle" and difficulty through damaged plates may be encountered if it is worked in this range.

When local heating is necessary, it should be done over the largest area possible and the use of drift pins should be reduced to a minimum. In all laying up, a large area flatter should be used so that no markings whatever are made in the sheet, or, to be more exact, the sheet surface should not be fiber stressed or cut in sections by the marking of a hammer. In rolling high tensile alloy steel, more time is required, due to the toughness of the metal and the application of pressure on the rolls should be placed on minimum sections at more frequent intervals. Where nickel steels are used, the service demands are exacting and are such that exceptional strength and ductility are required. For this reason, patching is to be regarded as a doubtful practice unless it is done by competent men under proper supervision.

The bulletin on "Nickel Alloy Steels in Railroad Locomotives" discusses the effect of heating and cold working on nickel steel. This bulletin can be obtained from the International Nickel Company, Inc., New York.

Plugs Used To Secure Tight Seams

Q.—What is the purpose of the 7/8-in. plug on the longitudinal center line of a locomtive boiler seam, located between the outside welt and the adjacent shell course?—C. B.

A.—The purpose of the 7/8-in. plug between the outside butt strap and the shell course is to secure a tight seam.

The joint of the shell course to which the seam is attached is located on the longitudinal center line of the seam. Owing to the fact that the edges of the inside welt strap are not calked, the tightness of the seam is dependent upon the calking of the outside butt strap. The calking of the outside butt strap causes the seam to be tight at all points except the short space between the end of the butt strap and the shell plate of the adjacent course. This space is provided between the end of the outside butt strap and the adjacent shell course to allow room for calking both the end of the butt strap and the adjacent shell course.

In order to secure a tight seam, a screwed plug is inserted between the end of the outside butt strap and the adjacent shell course. The diameter of the plug must be large enough to fill this gap. The threaded plug produces a tight seam at this point.

Quantity of Water Discharged Through Blow-Down Valve

Q.—(1). Given a locomotive boiler under 200 lb. per sq. in. steam pressure, what quantity of hot water in pounds and gallons would be discharged to the atmosphere per second through a 2-in. straight blow-down valve?

(2). Can you give a simple formula for figuring similar problems under varying steam pressures? I find textbook formulas on steam flow and cold-water flow do not give correct results, and can find no tables on hot-water flow under pressure. —W. C.

A.—(1). The formula for computing the flow of water under pressure through an orifice is:

$$V = 0.98 \sqrt{2g\,(h + h_1)}$$

where:

V = velocity of flow in ft. per sec.
g = force of gravity in ft. per sec. Per sec. = 32.16
h = head in ft.
h_1 = head due to pressure = $\frac{P}{0.434}$
P = pressure in lb. per sq. in. 0.434 = lb. per sq. in. due to one foot of head.
0.98 = the coefficient of velocity.

The coefficient of velocity is empirical. Experiments indicate that it is approximately 0.98 and varies very little with the head.

The formula for quantity of flow is:

$$Q = 0.62\,AV$$

where:

Q = discharge in cu. ft. per sec.
A = area of orifice in sq. ft.
V = velocity of flow in ft. per sec.
0.62 = coefficient of contraction.

The coefficient of contraction is empirical. It is the relation of the area of the orifice to the area of the jet at a distance out from the opening about one-half its diameter and is taken about 0.62 of the orifice area.

The formula does not take into consideration the change in the head above the blow-off cock due to the

discharge. The effect of the change of head would be very small considering that the head due to pressure is so much greater than the head due to the height of the water in the boiler.

Assuming that the head due to the height of the water in the boiler above the blow-off cock is 6 ft. and substituting the values given in the question, we have:

$$V = 0.98\sqrt{2 \times 32.16\left(6 + \frac{200}{0.434}\right)}$$

$$= 0.98\sqrt{64.32\ (6 + 460)}$$
$$= 0.98\sqrt{64.32 \times 466}$$
$$= 0.98\sqrt{29{,}973.12}$$
$$= 0.98 \times 173.1$$
$$= 169.64 \text{ ft. per sec.}$$

$$Q = 0.62 \times \frac{3.142}{144} \times 169.64$$

$Q = 2.294$ cu. ft. per sec.
1 cu. ft. water = 7.481 gallons
$2.294 \times 7.481 = 17.16$ gallons per sec.

The weight of water varies with the temperature. The temperature varies with the pressure. From Marks and Davis steam tables, we find that at a pressure of 200 lb. per sq. in., the temperature of the water is 381.9 deg. F. Assuming that the temperature is uniform throughout the boiler and taking the weight of one cubic foot of water at a temperature of 381.9 deg. F., as 54.276 lb., the weight of the water discharged per second would be $2.294 \times 54.276 = 124.5$ lb. per sec.

Computing Back-Head Stays

Q.—Is it correct in computing the number of braces required to support a back head of a locomotive boiler to multiply the area to be stayed by the boiler pressure and divide by the allowable stress that can be carried by the diameter of the stay to be used?—R. H.

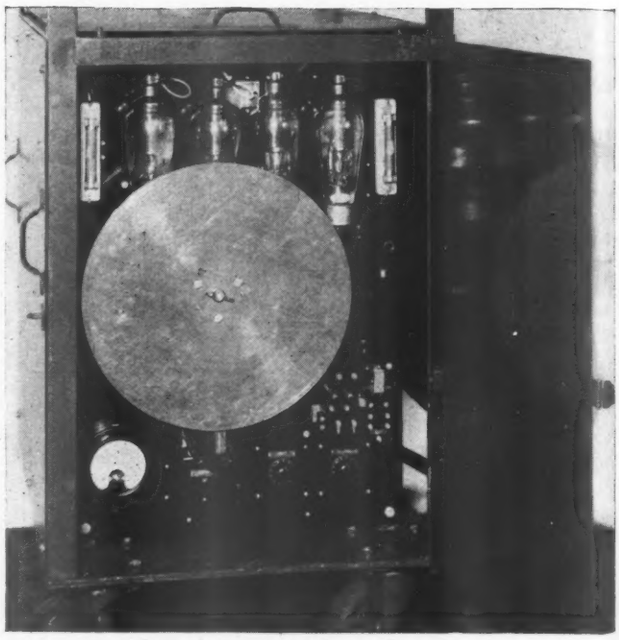
A.—The method outlined in the question would provide an ample number of stays to support the back head if the back head could be considered as a whole or it were possible to space the stays so that an equal distribution of the total load were placed on each stay. With the locomotive back head, this is practically impossible, due to the irregularity of the area to be stayed and the necessity of providing space for washout plugs and other appurtenances.

A better method would be to multiply the area to be stayed by the boiler pressure and divide the allowable stress per square inch for the type of stay used, thus obtaining the required cross-sectional area of all the stays. The area to be stayed should then be divided for any desirable spacing of the stays and the size or diameter of the individual stay should be based on the actual load that the individual stay is to carry due to the spacing. Precaution should be taken so as not to exceed the maximum allowable pitch of the stays for the thickness of the plate.

The total cross-sectional area of the stays used should be not less than the computed required cross-sectional area of all the stays.

Ignitron Seam Welder

An ignitron seam-welder control utilizing ignitron tubes has been developed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. This control times the power impulses in terms of a definite number of power cycles to a wheel-type electrode resistance-welding machine. Among its features is an inductive timer consisting of a synchronous disc rotating once per second and containing 120 holes, each corresponding

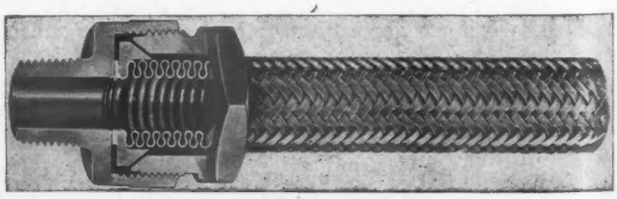


Inductive timer of Ignitron seam welder

to a half cycle of welding current. Also, the use of ignitron tubes permits a design utilizing no voltages higher than line voltages and eliminating the need of power contactors and transformers. Steel pins are plugged into the holes according to the timing desired. The control is simple and durable, and the timing is precise. The use of this control is said to improve the quality of welds for light-gage steels. It is especially suitable for welding heavy-gage steels which demand heavy welding currents, and for welding special metal alloys such as aluminum and olympic bronze which demand accurate timing and often heavy current.

Detachable Flexible Coupling

Simplicity is the feature of the illustrated heatproof detachable coupling for use with American seamless flexible tubing. Up to this time couplings that have been intro-



The American detachable flexible coupling

duced have lost some of their value in the complexity of detaching and reattaching. The coupling is made in three parts—the end nut, split ring and top part, all of which are shown in the sectional illustration. Either males or unions are available. The coupling has no rustable parts, and since it can be detached and reattached without use of special tools or being returned to the manufacturer, it directly reduces maintenance costs of the use of flexible tubing. It is made by the American Metal Hose Branch, The American Brass Company, Waterbury, Conn.

With the Car Foremen and Inspectors

Milwaukee Welded Automobile Cars

The Chicago, Milwaukee, St. Paul & Pacific completed building, a few months ago, a series of 1,000 automobile cars in its Milwaukee shops. These consisted of 500 50-ton cars, 51 ft. 7⅝ in. over striking castings and 500 40-ton cars, 41 ft. 7⅝ in. over striking castings. All-welded construction was employed in conjunction with high-tensile alloy steel, the production being 15 cars a day (50-ft.) and 18 cars a day (40-ft.), working three shifts. These cars, the largest of their type on the Milwaukee, have an inside height of 10 ft. 4 in. and an inside width of 9 ft. 2 in. They are featured by the use of Douglas fir plywood lining on the sides, ends and ceiling and the provision of staggered doors, 14 ft. 11 in. between posts for the 50-ton car, and an 18 in. by 16 in. lumber door at the *A* end of each car.

The entire inside of the car, including the roof, is lined with Douglas fir plywood

The cars were made on a production basis, employing the unit construction principle. Underframe, ends, sides and roof were assembled and welded completely as independent units, and subsequently united in their proper relation in an assembly line. These cars employ a combination of arc and resistance spot welding. The resistance spot welding is accomplished by using an automatic single-resistance spot welder, indirect-resistance spot welder and series-resistance spot welder. A single-resistance spot welder is one employing two electrodes, one positive and one negative. Usually one stationary electrode is below the work and one movable electrode to which pressure is applied is on the top side.

In series and indirect-resistance spot welders, the current passes through the work twice. The electrodes are arranged so that pressure is applied to both electrodes, pressing the work onto a copper backing. When proper pressure is built up, the current automatically is turned on and in the case of the series welder two spots occur where the electrodes contact the work. An indirect welder uses one electrode as a dummy; no spot develops at one electrode because of a large contacting surface

One of the Milwaukee all-welded automobile box cars as completed ready for service

Frame welding position with underframe almost completely fabricated by welding

bringing the electrical resistance down below that required to heat the metal sufficient for welding.

Sides

The first step in the production of sides is the series-resistance welding of the side-sheet stiffeners to the side sheets. These stiffeners are of 14-gage material, formed to a trough section 1½ in. deep and 2¾ in. wide, with 1-in. flanges on either side of the trough to provide surfaces for spot welding. These stiffeners are on 26-in. centers so that there are three rows of stiffeners running longitudinally on the side of the car. The sheets are all 9 ft. 7½ in. in height and 4 ft. 3⅞ in. to 4 ft. 11⅞ in. wide. The stiffeners are generally 2 ft. 3 in. long so that six stiffeners are required per sheet. A wooden templet is utilized in conjunction with special layout tables for the purpose of determining the position of and tacking stiffeners in place by arc welding. These parts are arranged in proper sequence and made ready for series welding.

The series welder is equipped with timing device which regulates the length of the time between spots, welding

Car roof inverted for application of the Douglas fir plywood lining

Taylor-Winfield 440-volt, 133-kv.a. indirect welder applying side posts to side sheets by spot welding

DeVilbiss canopy-type spray hoods used in painting the cars

Truck position with one truck completed and another ready for assembly

time and pressure dwell. With this timing device it is possible to achieve a pace of 2.1 seconds per cycle or 1.05 seconds per spot including all handling time. While this operation is going on, sheets with stiffeners spot welded in place and side posts, which are formed Z-sections with 3-in. webs and with 2¼-in. flanges turned toward the inside of the car, are laid out in a side jig. The flange welded to the side is 1¾ in. for the ordinary post and for posts which form a backing for the joining of sheets, the flange is 2⅜ in. These are laid out and tacked to the sheets.

Under each post, an 8-in. copper bar, 10 ft. long, is embedded in the jig, completing the electrical circuit for an indirect resistance spot welder which welds the assembly together and completely welds as many posts as possible to the sheets with spots on 2-in. centers. When the series welder completes the cycle of applying stiffeners to side sheets the entire assembly, laid out and partially completed under the indirect welder, is moved forward and the balance of the spot welding required to complete the side assembly is accomplished in the series welder. The side sheets, completely spot-welded together, are moved along to a jig where the upper side-sill element, door post, side plate, corner gusset, etc., are placed and arc welded. The final side operation is to turn the entire assembly to another adjacent jig where all vertical and horizontal joints are arc welded with a continuous bead. In this same position the drip cap, upper door rail and doors are applied. This jig is long enough to accommodate two complete sides so that the side is moved on rollers to a second position where all scale resulting from welding is removed, employing a small high-speed air chisel.

Ends and Roofs

The Dreadnaught ends are formed in two halves which are spaced ⅛ in. apart in a jig and welded together. In this same jig, hand brakes and safety appliances are applied to the ends. The safety appliances are riveted in place in order to conform with the safety-appliance code which does not yet recognize welding as a proper method for applying these parts.

The roof is the patented Hutchins Car Roofing Company's product of pressed-pan construction. These pans are welded together in a jig for that purpose and, at the same time, the running board brackets and the running

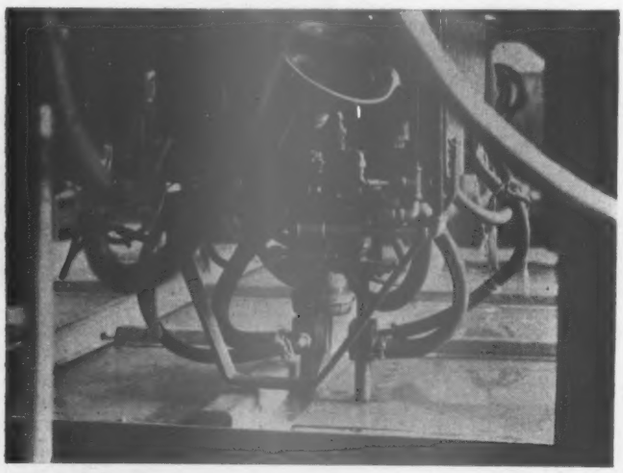
boards are welded in place. The roof is then turned over, red-leaded and the plywood ceiling applied so that it becomes a complete unit ready for erection.

Underframe

The underframe assembly commences with the bolster and crossbearer. Both of these items require two welding jigs, one merely for determining the position of the various parts and the tacking thereof, and second, a welding table. In the case of the bolster, which is heavier than the crossbearer, a revolving welding table in the form of a barbeque stand is used so that the welder can work in a most convenient position at all times. All outside welds of these items are of a continuous bead.

The center sills are made up of a combination of Z-sections 40 ft. 10⅛ in. long (for the 40-ton car), 12 $^{3}/_{16}$ in. high, weighing 31.3 lb. per ft. These are welded together in a jig equipped to hold two center-sill assemblies at one time. They are welded on the inside with intermittent welds of 12 in. weld and 12 in. skip over the center half and the ends are welded with a continuous bead to the filler casting and between the filler and center casting. There is also a small amount of plug welding of the castings to the center sill. In this same position the center and filler castings are riveted to the center sill.

The center-sill assembly is moved to the next position where the bolster, crossbearer, floor stringers and side sill are completely welded in place, in an upside down position. The entire assembly is moved to another jig where the piping and air-brake parts are applied and the necessary brackets welded in place. In the next position the underframe is right side up and whatever welding is required in this position, such as on the center sill where the sills are welded continuously over the striking casting and bolster, is completed.



The electrodes in the welding head of the Taylor-Winfield machine

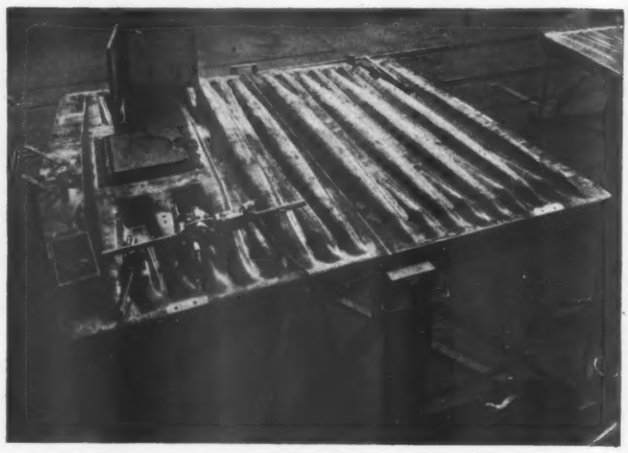
Assembly

The respective parts are now complete as units and ready to set the underframe on its trucks which are also pre-assembled. Sides, ends and roof respectively are applied in following positions and all welded together to form one component unit. All welds joining these parts are a continuous bead except that the roof is plug welded to the side plates and ends by means of $^{11}/_{16}$-in. plugs on a 5¼-in. center.

The car structure being completely welded together, it is thoroughly cleaned, red leaded, two coats of mineral paint sprayed on, stencilled, the floor is laid and bolted in place, interior plywood finish is applied, interior sprayed with aluminum paint, and the car then inspected and released.

There are approximately 1,300 linear feet of arc welding and 3,860 spot welds required in the assembly of one 50-ft. automobile car. In the 40-ft. automobile car there are 1,060 linear feet of arc welding and 3,600 spot welds per car.

It is interesting to note that the weight of an average single-sheath automobile car is 56,400 lb. for a 50-ft. car and 46,000 lb. for a 40-ft. car, as compared with 47,400 lb. and 41,200 lb., respectively, for all-welded cars. This weight saving is accomplished entirely in the body construction as no saving of weight was effected in the trucks or in any of the specialties such as brakes, couplers, draft gears, etc.



Special jig used in welding two-piece steel ends, applying hand brake, etc.

Air-Conditioning Instruction Car

The Missouri Pacific recently equipped one of its coaches as an air-conditioning and electrical-equipment instruction car which visits various operating terminals for periods of one to four days. The car is in charge of a competent instructor and classes for maintenance forces and train crews are held at convenient hours to obtain the largest attendance.

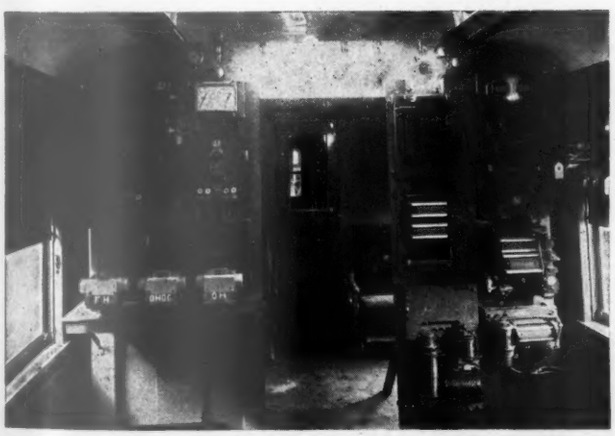
This instruction car was built and the course of instruction instituted because it was realized that the operation of car electrical equipment and air-conditioning apparatus is in the hands of the train crews who have had little or no electrical or mechanical training, and that the maintenance of the equipment is something relatively new to most of the maintenance forces. When there were but few air-conditioned cars in service it was possible to instruct train crews and maintenance forces individually, but this became impossible as the number of air-conditioned cars increased. Realizing that mechanics and train crews would have to be instructed along totally different lines, the car was divided into two sections, both of which are used for instructing maintenance forces but only one of which is used for instructing train crews.

The end of the car used for train-crew instruction is shown in one of the illustrations and contains exact duplicates of the control equipment used on Missouri Pacific steam-ejector, electro-mechanical and ice-acti-

vated air-conditioned cars. This end also contains working models of various types of automatic heating equipment in use on the Missouri Pacific. All of this equipment is completely wired, and by a simple switching arrangement it is possible to duplicate any condition encountered in actual service. The automatic heating equipment is actuated by thermostats which obtain the heat for their operation from 15-watt light bulbs placed directly under the thermostatic tubes. When the equipment cycles off by thermostatic action this light goes out and the tube cools. When it has cooled sufficiently, the thermostatic circuit is broken by the mercury in the tube and the heating equipment automatically goes to the "on" position. The use of this method permits an exact duplication of actual service operation of automatic heating equipment. By using "stick" circuits any magnetic valve can be stuck in either the open or closed position. This feature is very useful in demonstrating to train crews the indication and effect of stuck magnetic valves and instructing them in the proper procedure to follow when troubles of this nature occur.

The heating control circuits are so wired that the same valves are actuated by four different types of control equipment. In this end of the car are also located all types of generator regulators, lamp regulators and other electrical control equipment in general use on Missouri Pacific cars. This equipment is used principally for the instruction of maintenance forces, but it is also useful for instructing train crews in the location of various fuses and the safe method of replacing them if they burn out enroute.

The other end of the car which is shown in another of the illustrations, is devoted entirely to the instruction of maintenance forces. The seats were removed from one side of the car and replaced with a long table on which is mounted cutaway sections of all essential parts of the various types of air-conditioning systems. There are also two large diagrams of the steam-ejector system and two blackboards for diagraming and explaining



One end of the car is equipped with control apparatus for the instruction of train crews

problems which arise in maintenance work. It also contains a standard car-lighting generator which can be motored from any of the generator control equipment located in the other end of the car.

Power for operating pumps, fans and control equipment is secured from a 36-cell 45-volt Edison battery which has a 32-volt tap. With both 45 and 32 volts available, it is possible to reproduce a condition identical with that which obtains when the train is running or standing.

The introduction of air conditioning has changed entirely the standard of car electrical work and all maintenance men are required to visit the car and demonstrate their proficiency in the adjustment of regulators, automatic switches, contactors, relays, etc. The lamp regulators are so wired that they can be loaded from 5 to 75 amp. and are connected on both the regulated and

Cut-away models and diagrams of air-conditioning and car electrical apparatus are used for the instruction of maintenance forces

unregulated sides to a volt-ammeter which serves as a check on the regulator adjustments made by the maintenance men.

During the first trip over the Missouri Pacific, 728 trainmen and 60 maintenance men received instruction in the car.

Questions and Answers On the AB Brake

Operation of the Equipment (Continued)

161—*Q.—How long does the local brake-pipe reduction into the quick-service volume continue?* A.—Until the slide valve moves, at which time the quick-service volume is cut off.

162—*Q.—What becomes of the remaining air pressure in the quick-service volume?* A.—As this volume is always connected to the atmosphere through the preliminary quick-service choke, the remaining air is exhausted.

163—*Q.—What takes place in the emergency portion during the period known as preliminary quick service?* A.—The emergency piston and graduating valve assume service position.

164—*Q.—In what direction and how far does the emergency piston move?* A.—To the right until the piston-spring guide strikes the left end of the emergency slide valve.

165—*Q.—Is the quick-action charging choke now open?* A.—No, in this position it has been closed by the piston.

166—*Q.—What reduction of pressure is now being made in the emergency portion, in addition to that of the brake pipe?* A.—Quick-action-chamber air is being exhausted to the atmosphere via the vent port through the graduating valve to a port in the slide valve which registers with the exhaust port in the emergency slide-valve seat.

167—*Q.—At what rate is this reduction being made?* A.—At the same rate that brake-pipe pressure is reduced on the face of the emergency piston.

168—*Q.—Why is the reduction of quick-action-chamber air made?* A.—To keep quick-action-chamber pres-

sure from attaining a differential over the brake pipe.

169—*Q.—What is the reason for this precaution?* A.—If this were not done, the higher quick-action-chamber air would exert sufficient force against the emergency piston to compress its spring. This would allow the graduating valve to uncover a port connecting quick-action-chamber air to the emergency-piston chamber causing an emergency application.

170—*Q.—What is the general effect of this feature?* A.—By this means the valve is stabilized against an undesired emergency application, and the emergency application is made available at any time.

171—*Q.—During the preliminary quick-service reduction, has any braking pressure been developed?* A.—No. The service slide valve has not moved, and the brake cylinder is still connected to the atmosphere through the retaining valve.

172—*Q.—Has any reduction of auxiliary-reservoir pressure taken place as yet?* A.—No.

173—*Q.—At what stage does brake-cylinder pressure begin to develop?* A.—When the auxiliary-reservoir pressure has attained a sufficient differential over the brake pipe to move the service piston to the extreme left, into service position.

174—*Q.—What pressures connect with the brake cylinder at this juncture?* A.—The brake cylinder is connected indirectly to the auxiliary reservoir and brake pipe.

175—*Q.—How does the brake-pipe air pass to the brake cylinder?* A.—From a passage leading to the service slide-valve seat, connecting with cavity *D* in the slide valve, thence through a passage to the limiting valve, lifting the back-flow check and flowing past the limiting-valve check to the under side of the limiting-valve diaphragm. From there the pressure flows to the brake cylinder via the inshot valve.

176—*Q.—In what way is the auxiliary reservoir connected to the brake cylinder?* A.—Past the right end of the graduating valve, through the service slide valve and seat to passages leading to the brake cylinder through the inshot volume and the inshot valve.

177—*Q.—What causes the inshot valve to remain open at this time?* A.—Brake-cylinder air flows through a passage in the emergency portion through cavity *K* in the emergency slide and through a passage to the inshot volume and chamber at the left of the inshot piston. Brake-cylinder pressure is now on both sides of the inshot piston. As the spring at the left of the piston is stronger than the one to the right of the inshot valve, the piston and valve move to the right. The inshot valve is still open and a direct build-up of brake-cylinder air is permitted.

178—*Q.—What limits the amount of brake-pipe flow to the brake cylinder?* A.—As the brake cylinder pressure is built up, it also increases under the limiting-valve diaphragm. When this pressure is approximately 9 lb. the diaphragm is deflected upward against the force of its spring, allowing the limiting-valve check to close, due to the force of the spring beneath the check.

179—*Q.—What does the closing of the limiting valve bring about?* A.—It cuts off the flow of brake pipe air to the brake cylinder and ends all quick-service activity.

180—*Q.—When cycling on descending grades what degree of quick service is obtained when the brakes are reapplied with the retainer in holding position?* A.—The first quick-service stages, as covered in preliminary quick service. The additional quick service, which is obtained with an initial application, is cut off when approximately 10 lb. brake-cylinder pressure is retained.

181—*Q.—What movement takes place in the emergency portion during service?* A.—The same as described for preliminary quick service.

182—*Q.—What movement of the service portion takes place when the valve assumes service lap position?* A.—When the desired brake-pipe reduction has been made, and auxiliary-reservoir pressure has been reduced slightly below the brake-pipe pressure, the service piston and graduating valve move to the right until the piston stem engages the slide valve.

183—*Q.—What is the result of this movement.* A.—The graduating valve blanks the service port and cuts off the flow of air from the auxiliary reservoir to the brake cylinder.

184—*Q.—What takes place in the emergency portion at this time?* A.—The emergency piston and graduating valve return to the charging position.

Decisions of Arbitration Cases*

(The Arbitration Committee of the A.A.R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Charge for Brake Beams Prior to Authorization of Betterment Charge

During April, May, June and July, 1934, the Chicago & North Western applied 167 No. 15 brake beams to Pacific Fruit Express cars to replace 160 No. 2 plus and seven No. 2 brake beams which had been removed. A net material charge of $4.08, in addition to the usual labor charge, was made for each substitution for a No. 2 plus beam and $4.18 for each substitution for a No. 2 beam.

The car owner requested the repairing line to confine the material charge to the value of the No. 2 plus beam citing Section (e) of Rule 17 and Interpretation No. 19 of the same rule in effect at the time of repairs. The C. & N. W. declined to honor the claim because of the fact that, after the No. 15 brake beams had been adopted as the A.A.R. standard by letter ballot action on March 1, 1934, it discontinued perpetuating the No. 2 plus brake beam and confined purchases of new brake beams for freight cars to the No. 15 beam. When the supply of No. 2 plus brake beams at repair points became exhausted it was necessary to use a No. 15 brake beam in lieu of a No. 2 brake beam in order to make proper repairs and expedite the movement of cars. In the absence of an arbitrary price covering this brake beam prior to August 1, 1934, the C. & N. W. billed car owners at invoice cost plus 15 per cent which resulted in a lower charge than the price set up in the rules effective August 1, 1934.

In a decision rendered Nov. 14, 1935, the Arbitration Committee said, "Although the No. 15 brake beam had been adopted by letter ballot as an A.A.R. standard as of March 1, 1934, no prices for same were incorporated in the Interchange Rules until August 1, 1934. This being the case, and as repairs were made prior to August 1, 1934, charge for the No. 15 brake beams applied in place of No. 2 and No. 2-plus standard to car, should be confined to price of the No. 2-plus beam in effect on date of repairs. The contention of the C. & N. W. is not sustained."—*Case No. 1747, Pacific Fruit Express versus Chicago & North Western.*

* (Note—A number of readers have inquired during recent months as to the reason for the discontinuance of publication of abstracts of arbitration decisions. The decision presented here, in Case No. 1747 is the first released for several months. The decision in Case No. 1746 was published on page 118 of the March, 1936, issue of *Railway Mechanical Engineer.*)

The B. & O.'s latest development in steam power beside its 3,600-hp. Diesel-electric

NEWS

P.R.R. Builds Passenger Cars

THE Pennsylvania has about completed in its Altoona, Pa., works the construction of 100 modernized passenger cars, comprising 60 coaches, 8 combined passenger-baggage cars, 30 dining cars and 2 safe-coaches.

1,000 Car Order to Require Opening of A. C. F. Plant

FOLLOWING receipt of an order for 1,000 ballast cars,. which will be built for the Rodger Ballast Car Company for delivery to the Union Pacific, the American Car & Foundry Company will reopen its plant at Madison, Ill., on a large scale for the first time in seven years. The wheel department of this plant was reopened about three months ago and employs about 125 men. About 700 more men will be needed for the car department.

Smoke Prevention Convention Cites Railroad Aid

AT the 1937 convention of the National Smoke Prevention Association in New York it was brought out in various discussions that the railroads entering large cities have reduced to a minimum that fraction of total air pollution attributable to locomotives. At the sessions reserved as "Hudson County (N. J.) Day," J. L. Hodges of the Department of Smoke Regulation, Hudson County, cited statistics revealing that the trunk line railroads terminating on the New Jersey shore opposite New York City have reduced locomotive smoke from 23.5 per cent of the total pollution in 1931 to 1.24 per cent in 1937, as recorded through the facilities of the Hudson County Smoke Prevention Association. These figures compare favorably with the results of similar tests made at Stevens Institute, Hoboken, N. J.

Davis of Stevens A.S.M.E. Presidential Nominee

NOMINATIONS for officers of the American Society of Mechanical Engineers for 1938, as announced by the nominating committee at Detroit, Mich., during the semi-annual meeting of the Society, May 17 to 21, are the following: For president: H. N. Davis, president, Stevens Institute of Technology, Hoboken, N. J. For vice-president, to serve one year: F. O. Hoagland, master mechanic, Pratt & Whitney Division, Niles Bement-Pond Co., Hartford, Conn. For vice-presidents, to serve two years: B. M. Brigman, Dean, Speed Scientific School, University of Louisville, Louisville, Ky.; Harte Cooke, mechanical engineer, American Locomotive Company, Diesel Engine Division, Auburn, N. Y.; W. H. McBryde, consulting engineer, San Francisco, Calif., and L. W. Wallace, director, equipment research, Association of American Railroads, Chicago. For managers, to serve three years: Carl Bausch, vice-president, Bausch & Lomb Optical Co., Rochester, N. Y.; S. B. Earle, dean, School of Engineering, Clemson A. & M. College, Clemson College, S. C., and F. H. Prouty, Prouty Brothers Engineering Co., Denver, Colo.

Pennsylvania Developing a New Steam Locomotive

THE Pennsylvania, in co-operation with a committee of engineers of the Baldwin, American and Lima locomotive companies, is developing a new type of steam locomotive to be known as "The Pennsylvania Type," it is announced by M. W. Clement, president of the road. A development of the conventional coal-burning steam type, to cost little more to build, operate and maintain than present locomotives of lesser capacity, the new unit will be capable of hauling a 14-car passenger train at 100 miles an hour and will render service comparable to the motive power on the electrified eastern lines of the road.

This type will be the largest, fastest, and most powerful steam engine ever designed primarily for passenger service on the Pennsylvania. Having the same general appearance as the streamline type of heavy steam passenger locomotive now in service, the new locomotive, a 4-4-4-4 type, will carry two pairs of cylinders on a rigid frame, each pair providing power for four driving wheels. The tender, mounted on two six-wheel trucks, will have a maximum capacity of 25,000 gallons of water and 26 tons of coal. As soon as one of the new type locomotives is completed, road and plant tests will be made to determine its practical adaptation to various transportation needs.

Recent B. & O. Locomotive Designs

RECENT additions to Baltimore & Ohio motive power include a 3,600-hp. Diesel-electric locomotive from the Electro-Motive Corporation—one of two similar units for service on the "Capitol Limited" between Washington, D. C., and Chicago—and a 4-4-4-4 type passenger steam locomotive named the "George H. Emerson" in honor of the present chief of motive power and equipment of the road.

Identical in capacity and wheel loadings with the locomotive recently built for the Santa Fe's "Super Chief," each of the 3,600-hp. streamline locomotives is composed of two 1,800-hp. units coupled for multiple-unit operation, with a single control station in the cab of the leading unit. The motive power for each 1,800-hp. unit is identical and consists of two 900-hp. Electro-Motive power plants controlled simultaneously from the main locomotive throttle. The total weight of each locomotive, with full fuel supply, water and sand, is about 569,000 lb.

The 4-4-4-4 type steam locomotive, completed on June 3 in the Mt. Clare shops of the B. & O., is a single-expansion unit having four cylinders cast in an integral frame, approximately 60 ft. long. It is equipped with a fire-tube boiler with water-tube firebox carrying 350 lb. pressure and has a rigid wheel-base of 6 ft. 7 in. Double-ported piston valves, which were discontinued several years ago, after installation on a number of B. & O. engines, have been reincorporated in modified design on the locomotive. The tender and engine, together, weigh 736,500 lb.

While designed specifically for passenger service, the locomotive can also be utilized in high-speed freight service.

New Enginehouse Construction

The Wabash is constructing, with its own forces, a reinforced concrete and frame enginehouse at Brooklyn, Ill., to replace a frame structure. The work is being done at a cost of $26,500.

The St. Louis Southwestern has undertaken the alteration and enlargement of its enginehouse at Pine Bluff, Ark., at a cost of about $90,000. Several small buildings have also been constructed at this point and new shop machinery has been installed. The total cost of the improvements will approximate $300,000.

The Chicago, Burlington & Quincy has awarded a contract to the B. Jobs Construction Company, Peoria, Ill., for additions and extensions to its enginehouse at Galesburg, Ill. This work, which will cost about $80,000, will involve the construction of a six-stall addition to the present enginehouse and the extension of three stalls. Another contract has been awarded to G. A. Johnson & Sons, Chicago, for the construction of a new six-stall enginehouse at Rock Island, Ill., at a cost of about $35,000.

N. Y. Commission Defines "Engine" in Helper Case

POINTING out that rolling-stock customarily known as a "motor-car" cannot be construed as comprising an "engine," the Public Service Commission of the State of New York, recently discontinued a proceeding brought on a complaint of the Brotherhood of Locomotive Firemen and Enginemen, alleging that the Erie is violating a state statute prohibiting the operation of any "fuel-electric engine" within the state unless it be manned by a crew of not less than one engineer and one fireman, or helper.

The equipment referred to in the case comprises gasoline-electric motor cars consisting of an engine compartment, which occupies less than one-quarter of the length of the car, and baggage, express and passenger compartments.

The commission's opinion states that the question arises as to whether the equipment in question may properly be called, in the ordinary acceptation of the term, "fuel-electric engines," and adds that the starting point of the case is the legal rule that, unless a term is defined in the statute, it is to be considered as it is generally understood. It felt that an "engine," as currently known, does not carry passengers or property and does not include compartments for the handling of mail, express or baggage but is solely, or at least primarily, for the purpose of hauling or moving other rolling-stock.

Power Reverse Gear Order Mandatory

HOLDING that "the use on steam locomotives of manually operated reverse gear, as compared with power reverse gear, causes unnecessary peril to life or limb, and that the safety of employees and travelers on railroads requires that suitable power-operated reverse gear shall be substituted for manually operated reverse gear," the Interstate Commerce Commission, speaking through Commissioner McManamy, on June 14, issued an order requiring the installation of power reverse gear on all new steam locomotives built after September 1, and further specifying that all steam locomotives used in road service built prior to September 1, which weigh on driving wheels 150,000 lb. or more, and all steam locomotives used in switching service built prior to September 1, which weigh on driving wheels 130,000 lb. or more, shall have a suitable type of power-operated reverse gear applied the first time after September 1 that these locomotives are given repairs defined by the United States Railroad Administration as class 3 or heavier. The order goes further to say that all such locomotives shall be so equipped before September 1, 1942. In installations where steam connections to air operated power reverse gear are used, the operating valves shall be conveniently located in the cab of the locomotive and so arranged and maintained that in case of air failure steam may be quickly used to operate the reverse gear.

The report estimates the cost of installation of power reverse gear on locomotives that do not now have it at about $5,000,000. The commission does not feel that the cost of equipping these locomotives will be unduly burdensome to the carriers, for, as the report says, "the record justifies a conclusion that the additional cost of equipping with power reverse gear a locomotive receiving class 1, 2, or 3 repairs is negligible."

I.C.C. Hears Arguments in Power Reverse Gear Case

ON May 18 the Interstate Commerce Commission heard arguments as to the advisability of issuing a formal order requiring the railroads to install power reverse gears in their locomotives. Joseph H. Wright, counsel for the Illinois Central, and W. Carter Fort, of the Association of American Railroads, strongly urged the commission to either dismiss the case or simply reserve decision on it and let the railroads and the brotherhoods work out the agreement which has been reached with 131 Class I railroads. Mr. Fort said that the agreement included 97 per cent of all the locomotives owned by the railroads of the United States. He strenuously objected to the examiner's report in the power reverse gear case and said that the reading of the case will not disclose whether the hand gear or the power gear is the most dangerous.

Coming to the question of the agreement which has been signed by both the Brotherhood of Locomotive Engineers and the railroads, Commissioner McManamy asked

(*Turn to next left-hand page*)

New Equipment Orders and Inquiries Announced Since the Closing of the June Issue

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
Baltimore & Ohio	2 [1]	3,600-hp. Diesel-elec.	Electro-Motive Corp.
Canton R. R. Co.	1	600-hp. Diesel-elec.	Electro-Motive Corp.
C. & N. W.	1 [2]	4-6-4	American Loco. Co.
Chinese Ministry of Railways.	10	2-8-2	Baldwin Loco. Wks.
	10	2-8-2	American Loco. Co.
East Erie Commercial R. R.	1 [3]	300-hp. Diesel-elec.	General Elec. Co.
N. Y., N. H. & H.	6	3,600-hp. d.c. elec.	General Elec. Co.
Norfolk & Western	10 [4]	2-8-8-2	Company shops

Locomotive Inquiries

C. M., St. P. & P.	1 [5]	Pass.	.....
Newfoundland	1	2-8-2	.....

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
C. M., St. P. & P.	1,000 [5]	Gondola	Company shops
Norfolk & Western	20 [4]	Caboose	Company shops
	10 [4]	Hopper	
Owens-Illinois Glass Co.	50	Hopper	Gen. Amer. Trans. Corp.
Seaboard Air Line	200	50-ton auto. box	Pullman-Std. Car Mfg. Co.
Union Pacific	2,788 [6]	Frt.	Company shops
United States Sugar Corp.	60	30-ton cane	Magor Car Corp.

Freight-Car Inquiries

C. & N. W.	50	Caboose-car underframes	.....
Ill. Central	25	50-ton hopper	.....
M. St. P. & S. S. M.	100	50-ton box	.....

PASSENGER-CAR ORDERS

Road	No. of cars	Type of car	Builder
Canadian National	10	Mail-express	Canadian Car & Fdry. Co.
C. R. I. & P.	10	Coaches	Pullman-Std. Car Mfg. Co.

Passenger-Car Inquiries

New York Central	6	Diners	.....
	4	Bagg. and mail	.....

[1] Delivered.
[2] In addition to eight ordered in February.
[3] Equipped with Cooper Bessemer power plant.
[4] The Norfolk & Western will construct at an approximate cost of $1,600,000 in its Roanoke, Va., shops 10 heavy freight locomotives of the Y-6 (2-8-8-2) class, 20 new all-steel caboose cars and 10 all-steel covered hopper cars of 70 tons' capacity, the latter designed for hauling cement and similar commodities. Material for these new locomotives will be ordered immediately and construction will start about October. It is expected that four of the locomotives will be completed this year. They will be equipped with roller bearings, mechanical lubrication, will have a tractive force of about 127,000 lb. and locomotive and tender weight, in working order, of 961,500 lb. The locomotives are to be the same type (Y-6) as five others built at Roanoke last year. The shop forces will start construction on the 20 caboose cars as soon as plans are completed and material received.
[5] Purchase authorized by the Federal district court at Chicago, the locomotive at a cost of $125,000, and the gondola cars at a cost of $2,562,000.
[6] The Union Pacific has placed orders with company shops for 2,788 freight cars, instead of 2,600, as reported in the June issue. Of these, 2,088 box cars will be constructed at the Omaha and Portland shops, while 700 auto box cars will be constructed at the Grand Island shops. In addition, orders will be placed with company shops, or outside builders, for 100 special box cars, but inquiries have not yet been issued.

STEAM

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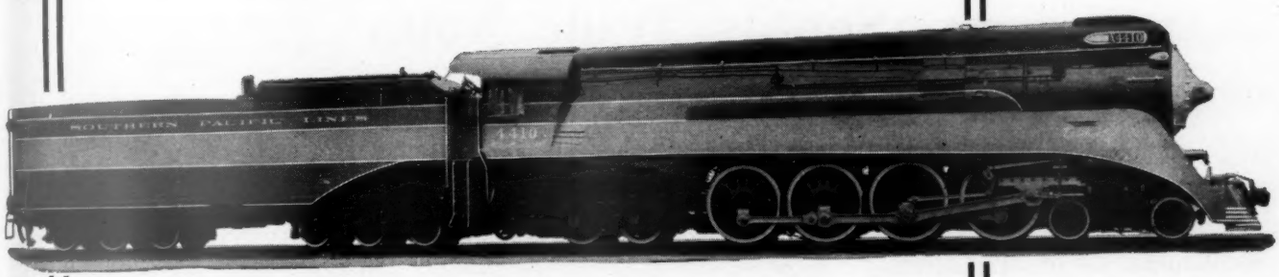

Modern Super-Power Steam Locomotives remove the limitation of speed due to motive power. They make it possible to operate with safety at any train speed permitted by other considerations.

Without introducing any unproven elements the Super-Power Steam locomotive meets all the requirements of high-speed passenger service.

LIMA LOCOMOTIVE WORKS, INCORPORATED
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Mr. Fort what recourse the employees had if the railroads chose to break the agreement. Mr. Fort replied that he thought that the lines would not dare to do such a thing. If they did, he did not feel that the unions would have any legal recourse.

Questioned by Commissioner Mahaffie as to whether the Brotherhood of Locomotive Engineers was willing to have the commission dismiss the case, H. M. McLaughlin, attorney for the Brotherhood, said that he did not know what their attitude would be on that question, but that he felt that the agreement was satisfactory and that the brotherhoods would live up to their part of it and that they expected the railroads to do the same.

Motion Picture Dramatizes Industrial Lubrication

A motion picture dramatization of lubrication methods in modern industry, which was developed by the Industrial Department of the Socony-Vacuum Oil Company, was shown for the first time recently in the preview theatre of Radio City Music Hall, Rockefeller Center, New York. The new film is done in a "March of Time" style. Animated drawing and photography are used to illustrate correct lubrication of various types of machinery.

The picture is called "The Inside Story." A microscopic film of oil assumes the hero's role in this industrial drama. But for this film of oil, the picture points out, many of the common daily conveniences of modern life, now within the reach of millions of people, would never have been possible. The story of the fundamentals behind correct lubrication is told by showing bearings, gears and cylinders—the essential elements of all machines—and demonstrating how they operate, how they are lubricated and the lubrication needs of various types.

Various bearings are shown and an animated drawing shows just what goes on inside, how lubrication prevents metal to metal contact. Factors to be taken into consideration in the selection of the proper lubricant are fully explained. In a similar way, the lubrication of gears is illustrated with animated drawings showing how a gear transmits power and how the lubricant provides protection. Another series of pictures shows the work that correct lubrication does in protecting the moving parts of various prime motors, the Diesel engine being selected as an example. Animated drawings make clear the principle upon which the engine operates and the manner in which explosions are translated into usable power. Further drawings illustrate what a lubricant must do if efficient operation is to be maintained.

The new film will be shown to business organizations and to groups of plant managers and factory executives in industrial communities throughout the country.

Supply Trade Notes

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has opened Pittsburgh, Pa., executive, sales, and lamp division offices, at 306 Fourth avenue.

FRANK M. MORLEY, formerly with the Bethlehem Steel Company, is now in the sales department of the Graham-White Sander Corp., with headquarters at Roanoke, Va.

C. MILES BURPEE, research engineer of the Delaware & Hudson, has resigned to become vice-president of the railroad division of the Chipman Chemical Company, Bound Brook, N. J., with headquarters at Chicago.

STEEL AND TUBES, INC., Cleveland, Ohio, has moved its New York district sales offices, from 30 Rockefeller Plaza, to the Chrysler building, New York City; L. M. Hogan is district sales manager.

ROBERT W. LAW has been appointed division manager of the Boston, Mass., office of the A. M. Byers Company, 518 Consolidated building. Mr. Law has been with this company since 1925 as sales representative in the New York division.

THE HART & COOLEY MANUFACTURING COMPANY, Chicago, has added a second addition to its factory at Holland, Mich. J. H. Van Alsburg, engineer of application, has been promoted manager of the contract department, which handles all items manufactured for railroad use.

THE COLUMBIA STEEL COMPANY, subsidiary of the United States Steel Corporation, San Francisco, Cal., has made appointments in its general sales department, as follows: J. D. Fenstermacher has been appointed manager of sales, Steel Casting and Railroad Sales Division; E. S. Duval has been appointed manager of sales, alloy and stainless steel products, and F. R. Steckel assistant manager of sales, alloy and stainless steel products.

DUDLEY A. BONITZ, a sales representative of the Ryan Car Company, Chicago, has been appointed to the newly-created position of sales manager. C. D. Hicks has been appointed sales agent in the St. Louis territory with headquarters at 1218 Olive street, St. Louis.

J. P. BOORE has been appointed assistant general sales manager of the Babcock & Wilcox Tube Company, Beaver Falls, Pa. Mr. Boore served for several years as vice-president of the Summerill Tubing Company, and for 20 years prior to that was associated with the Pittsburgh Steel Company in the production and sales departments.

EVERETT D. GRAFF, first vice-president of Joseph T. Ryerson & Son, Inc., Chicago, has been elected president. W. F. Kurfess and V. H. Dieterich, assistant vice-presidents, have been promoted to vice-presidents; Ainslie Y. Sawyer, assistant vice-president, has been promoted to assistant to the president. All have headquarters at Chicago.

THE AMERICAN STEEL & WIRE CO., subsidiary of the United States Steel Corporation, officially opened its new modern continuous rod mills at Joliet, Ill., on June 23. These mills are part of a $5,000,000 improvement program begun in billet mills in Gary and South Chicago. The mills are the first rod mills to be equipped throughout with anti-friction bearings. The total annual capacity is 22,000 tons.

THE DAMPNEY COMPANY OF AMERICA, Hyde Park, Boston, Mass., has opened a branch office in the Citizens and Southern National Bank building, Atlanta, Ga., in charge of Ray W. Carter, as southeastern district representative. Mr. Carter, for the past six years, was in charge of the New York office. L. W. MacLean of the Philadelphia, Pa., office has been transferred to New York.

C. W. GILMER, manager mechanical sales, at the Seattle, Wash., branch for the Mechanical Goods Division of United States Rubber Products, Inc., has been transferred to the New York office as belting sales engineer, operating under T. A. Bennet, manager belting sales; L. F. Koepp, salesman in the Seattle district, has been appointed manager mechanical sales, succeeding Mr. Gilmer at the Seattle branch.

K. W. GREEN has been appointed manager of railway sales of The Electric Storage Battery Company, Philadelphia, Pa., manufacturers of Exide batteries. Mr. Green was graduated as an electrical engineer from Lehigh University, class of 1924. He then took the students' training course at the Bethlehem Steel Company, and worked in the electrical department for three years. He entered the employ of The Electric Storage Battery Company in July, 1927, and served for five years on the sales staff of the Pittsburgh branch before going to Philadelphia.

THE OFFICERS of the Burden Iron Company, Troy, N. Y., are now as follows: Joseph W. Burden, chairman of the board; Charles P. Franchot, president; Otis A. VanDenburgh, vice-president in charge of operation; Harold T. Henry, vice-president in charge of sales; Charles Downs remains as treasurer; Grace W. Foster, formerly assistant secretary, is secretary; George W. Heger is assistant treasurer; and William G. Shoemaker is assistant secretary. The company has moved its New York City office to 60 East 42nd street.

THE ELECTRO-MOTIVE CORPORATION has started another addition to its Diesel locomotive plant at La Grange, Ill. This addition, consisting of a one story building 360 ft. wide by 816 ft. long, and located west of the present main building, will be used for manufacturing Winton two-cycle

(Turn to next left-hand page)

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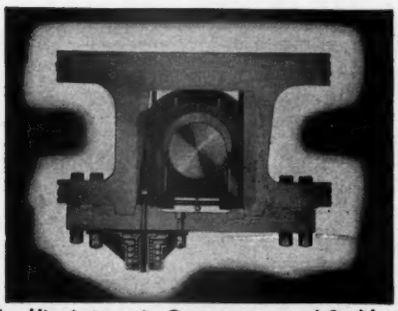
• LONGER LIFE

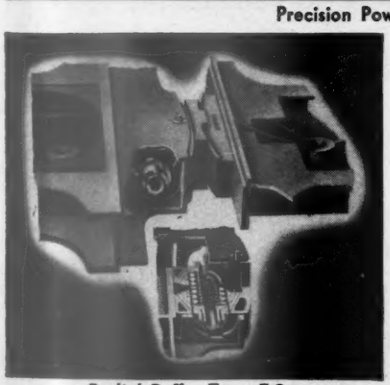
• LOWER COSTS

Franklin No. 8 Butterfly Type Firedoor



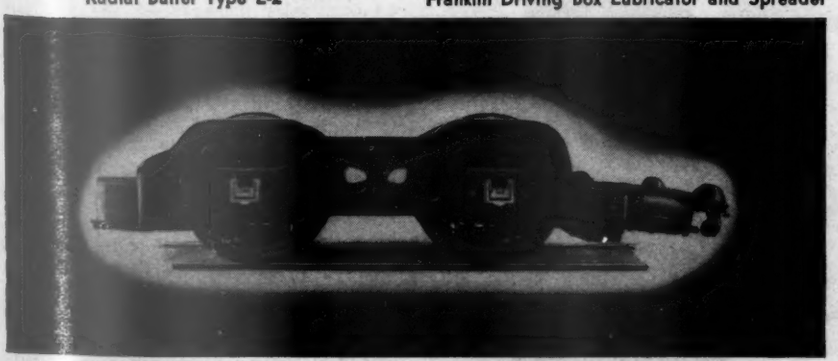
Franklin Automatic Compensator and Snubber

Precision Power Reverse Gear



Radial Buffer Type E-2

Franklin Driving Box Lubricator and Spreader



The Locomotive Booster

All these factors are built into Franklin Replacement Parts for Franklin Devices. » » » Replacement Parts are of major importance because they take the brunt of the service. » » » Into every Franklin Part is built the experience gained in the development of the device itself. » » » Only by duplicating this development work can this experience, essential to the making of duplicate parts, be gained. » » » Only by using genuine Franklin Replacement Parts for Franklin Devices can the same dependable performance and the same economy as given by the original part be obtained. » » » » » » » » »

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

Diesel engines supplementary to the facilities at the Winton plant in Cleveland. This is the second addition to the plant since it was completed in January, 1936. The first addition, which doubled the size of the main building, was placed in service three months ago.

J. J. SUMMERSBY, assistant vice-president of the Worthington Pump & Machinery Corporation, Harrison, N. J., has been appointed general sales manager of the corporation. This is an extension of Mr. Summersby's previous responsibilities, for a further concentration of direction of the corporation's general sales department. Mr. Summersby joined the corporation as a sales engineer immediately after his completion of post graduate work at Washington University in 1920, and he has been continuously in that service since that time as district sales manager, divisional sales manager and assistant general sales manager.

J. F. HOERNER, district manager at New York of the Baldwin Locomotive Works, has been appointed assistant general sales manager, with headquarters at Philadelphia, Pa. Victor E. Rennix, who entered the sales department in 1918, and was

J. F. Hoerner

transferred to Chicago as assistant to the district manager in 1933, succeeds Mr. Hoerner as district manager at New York, and Henry K. Patjens, who has been with Baldwin in the engineering department from 1919 until early in the present year, when he was transferred to the sales department, has been assigned to the Chicago district office, in place of Mr. Rennix. Mr. Hoerner started work with the Baldwin Locomotive Works in 1909 and served in the engineering department until 1915, when he was transferred to the New York sales force. From 1919 to 1921 he was assistant manager of the New York office and until 1928 was assistant to the vice-president at New York, since which time he has served as district manager at New York.

H. B. SPACKMAN, formerly general sales manager of the Steel Products Division of the U. S. Gypsum Company, Chicago, has been appointed general sales manager of Lyon Metal Products, Incorporated, Aurora, Ill., and will have supervision of all sales activity, including advertising and sales promotion. Mr. Spackman entered the employ of Lyon Metal Products, Inc., after 18 years experience in the metal fabrication industry. For nine years he was connected with the Northwestern Expand-

H. B. Spackman

ed Metal Company as a salesman and later as assistant general sales manager. Upon resigning from this company he entered the employ of the U. S. Gypsum Company, where he developed a steel equipment division for the marketing of building material specialties. He resigned as general sales manager of the steel products division of the U. S. Gypsum Company to become general sales manager of Lyon Metal Products, Inc.

D. W. LAMOREAUX, vice-president of the Journal Box Servicing Corporation, with headquarters at Chicago, has been elected vice-president of the Peerless Equipment Company, Chicago. Mr. Lamoreaux was born in Elmvale, Ont., in 1887 and entered railway service as a machinist for the Wheeling & Lake Erie at Brewster, Ohio. After holding this position for several years, he entered the employ of the Baltimore & Ohio and later the Pennsylvania and the New York Central, working up from the position of machinist to fore-

D. W. Lamoreaux

man and general foreman. He returned to the Wheeling & Lake Erie as general foreman and several years later resigned to become sales engineer for the National Refining Company, with which company subsequently he was promoted to manager of sales. He held the latter position until 1932, when he was elected vice-president of the Journal Box Servicing Corporation at Indianapolis. Two years later he was placed in charge of this company's Chicago office, which position he has held until his recent appointment.

A. A. HELWIG, president of the Peerless Equipment Company, Chicago, has resigned to become vice-president of the Standard Railway Equipment Company, Chicago. Mr. Helwig was born at Minneapolis, Minn., in 1892, and served his apprenticeship in the mechanical department of the Minneapolis & St. Louis. Later he was employed in train service on this railroad, the Great Northern and the Chicago, Milwaukee, St. Paul & Pacific. In 1915 he was appointed general foreman of the Alton at Kansas City, Mo., and the following year became traveling inspector in the mechanical department. In 1917 he entered the army as a second lieutenant and in 1920 resigned as a major after serving three years in France with the First Army Engineers. He returned to

(c) Moffett Studio

A. A. Helwig

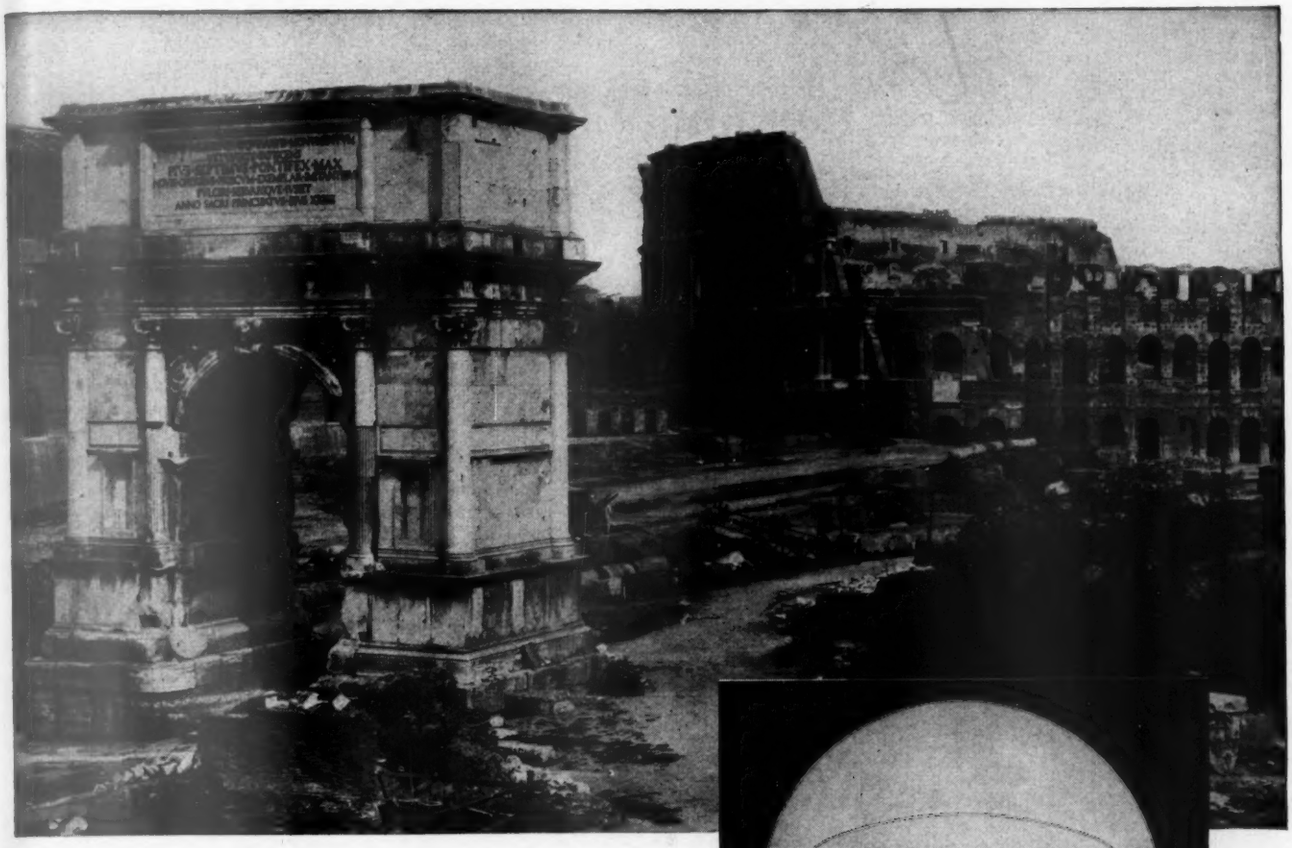
railroad service in that year as superintendent of the car department of the Kansas City Terminal Company at Kansas City, and in 1925 resigned to become southwestern sales manager of the Bradford Corporation, with headquarters at St. Louis, Mo. In 1930 he was elected vice-president at Chicago and in March, 1932, resigned to form the Peerless Equipment Company, of which he was elected president on January 1, 1936.

Obituary

WILSON WORKMAN BUTLER, president of the Canadian Car and Foundry Company, died recently at Montreal, P. Q. Mr. Butler was born at Danville, Ohio, on December 9, 1862, and was educated in that state at the Danville Select School. He gained his business experience in the service of the John Shillito Company, Cincinnati, Ohio, and as western manager for the Sterlingworth Railway Supply Company, Chicago. In 1901 he went to Canada and established the manufacturing plant of the Simplex Railway Appliance Company and afterwards founded the Dominion Steel Car Company, where the first Canadian all-steel railway car was built

(Turn to next left-hand page)

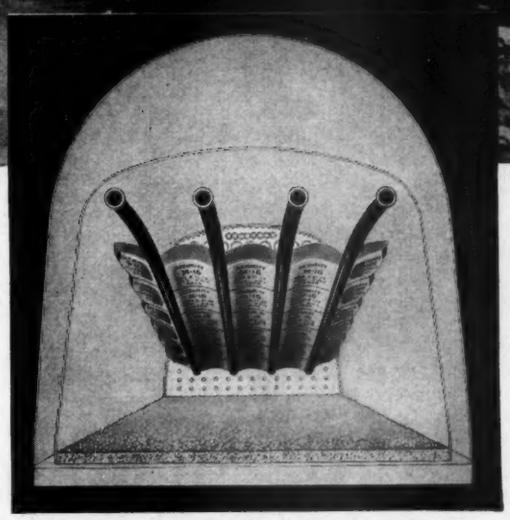
NO. 4 OF A SERIES OF FAMOUS ARCHES OF THE WORLD



ARCH OF TITUS, ROME

81 A. D.

The Arch of Titus erected A. D. 79-81 at the Eastern entrance of the Roman Forum to impress the imagination of the people with the grandeur that was Rome and to commemorate the capture of Jerusalem, is best known for its fine proportions and excellence of its details. The decorative panels on one side of the archway illustrate the Imperial Cortege, and on the other side a group bearing the spoils from the temple of Jerusalem. The frieze on the arch reproduces a number of other episodes of the triumph. A bronze quadriga was originally mounted on the top of the arch.

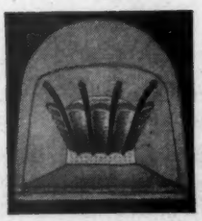


There's More To SECURITY ARCHES Than Just Brick

The Security Sectional Arch for the locomotive firebox was designed and developed to further the economy and effectiveness of the steam locomotive. Its development paralleled locomotive development. It is today an essential factor in the successful operation of high speed, high capacity trains.

HARBISON-WALKER REFRACTORIES CO.

Refractory Specialists



AMERICAN ARCH CO.
INCORPORATED

Locomotive Combustion Specialists » » »

under his supervision. Several years later Mr. Butler took an active part in the organization of the Canadian Car and Foundry Company, of which he was a director, as well as president. He was also president and director of the Canadian Steel Foundries, Ltd., and Pratt and Letchwork Company, Ltd. At various times he held business affiliations in the United States, including that of western sales agent for the American Car and Foundry Company, as second vice-president and director of the Simplex Railway Appliance Company, and second vice-president and director of American Steel Foundries.

Personal Mention

General

W. A. POWNALL, mechanical engineer of the Wabash, has been appointed assistant to superintendent motive power, with headquarters at Decatur, Ill.

W. H. SAGSTETTER, assistant superintendent motive power of the Wabash, with headquarters at Decatur, Ill., has resigned to become general mechanical superintendent of the Denver & Rio Grande Western, with headquarters at Denver, Colo. The position of general mechanical superintendent of the D. & R. G. W. has remained unfilled since the middle of 1936, when W. J. O'Neill resigned to become superintendent motive power of the Western Pacific. During the interim P. C. Withrow, mechanical engineer of the D. & R. G. W., has served as acting general mechanical superintendent.

W. B. WHITSITT, mechanical engineer of the Baltimore & Ohio, has been appointed assistant chief of motive power and equipment in charge of engineering and research work, with headquarters at Baltimore, Md. Mr. Whitsitt was born on May 27, 1883. He entered the service of the Baltimore & Ohio as draftsman in the motive-power department at Newark, Ohio, on March 16, 1903, and on April 1, 1907, was transferred to the Mount Clare shops at Baltimore. On October 1, 1915, he was appointed apprentice instructor at Mount Clare. He became assistant chief draftsman on September 1, 1917; chief draftsman on July 16, 1918, and assistant mechanical engineer on October 1, 1922. On November 1, 1926, Mr. Whitsitt was appointed mechanical engineer.

E. E. SANFORD, master mechanic of the Buffalo and Montpelier divisions of the Wabash, with headquarters at Montpelier, Ohio, has been promoted to assistant superintendent motive power, with headquarters at Decatur, Ill., to succeed W. H. Sagstetter, who has resigned. Mr. Sanford has been identified with the Wabash for 34 years. He was born on October 26, 1885, at Chariton, Iowa, and received his education at the University of Missouri. He entered railway service with the Wabash in January, 1903, as an apprentice in the mechanical department at Stanberry, Mo., where he later served as a machinist, and then general foreman. In 1920, Mr. Sanford was sent to Moberly, Mo., as enginehouse foreman, later being appointed general foreman at the same point. In 1926 he was promoted to assistant master mechanic, which position he held until 1931, when he was further promoted to master mechanic at Ft. Wayne, Ind. In 1936, his office was moved to Montpelier, where he remained until his promotion to assistant superintendent motive power.

J. J. TATUM, general superintendent of the car department of the Baltimore & Ohio, has been appointed assistant chief of motive power and equipment, in charge of the car department, with headquarters at Baltimore, Md. Mr. Tatum has been in continuous service of the Baltimore & Ohio for 58 years. He was born at Baltimore on September 17, 1866, and entered the service of the B. & O. as a messenger at the Mount Clare shops on his thirteenth birthday. From December, 1879, to November, 1881, he worked in the locomotive building and repair shop, and later served as apprentice in the car department. He became a car builder in 1885 and in September, 1886, became supervisor of air-brake equipment. In the following 12 years he occupied various positions in the shops in a supervisory capacity, and in 1898 became general foreman of passenger terminals. In 1900 Mr. Tatum was appointed chief inspector of new car equipment and, in 1902, was promoted to the position of general foreman of the car department, Baltimore terminals and shops. He became superintendent of freight car equipment in 1907 and during the war was manager of the car repair section under the U. S. Railroad Administration, with headquarters at Washington, D. C. He returned to the Baltimore & Ohio on March 1, 1920, as superintendent of the car department, in charge of both passenger and freight equipment, and on June 1, 1925, was appointed general superintendent of the car department.

J. J. Tatum

Master Mechanics and Road Foremen

W. G. RIECK, general enginehouse foreman of the Wabash at Decatur, Ill., has been appointed master mechanic at Montpelier, Ohio, to succeed E. E. Sanford.

A. G. GEBHARD, general foreman at the Markham (Chicago) roundhouse of the Illinois Central, has been promoted to master mechanic of the Louisiana division with headquarters at McComb, Miss., to succeed J. N. Chapman, who has been assigned to other duties.

LOUIS H. WIEBKING has been appointed road foreman of engines of the Baltimore division of the Baltimore & Ohio, succeeding F. C. Turnley.

F. E. TROGLER, traveling engineman, Pittsburgh division, of the Pennsylvania, has been appointed assistant road foreman of engines, Philadelphia Terminal division.

W. B. WEIGHTMAN, assistant road foreman of engines of the Philadelphia Terminal division of the Pennsylvania, has been appointed assistant road foreman of engines, Philadelphia division.

W. E. HARNISON, master mechanic of the Erie at Secaucus, N. J., has been transferred in the same capacity to Hornell, N. Y., and C. H. Norton, master mechanic at Hornell, has been transferred in the same capacity to Secaucus.

F. C. TURNLEY, road foreman of engines of the Baltimore division of the Baltimore & Ohio, has been appointed road foreman of engines of the Cumberland division, West End, succeeding C. Schuh, deceased.

M. G. STEWART, assistant road foreman of engines of the Philadelphia division of the Pennsylvania, has been appointed assistant road foreman engineer-assistant trainmaster, Wilkes Barre division, with headquarters at Mt. Carbon, Pa.

R. SKIDMORE, master mechanic in charge of the locomotive shop and enginehouse of the Kansas City Southern at Pittsburg, Kan., has had his jurisdiction extended to include the Northern and Kansas City Terminal divisions.

P. O. CHRISTY, general foreman of the Illinois Central at Centralia, Ill., has been appointed assistant master mechanic at Markham (Chicago), in which capacity he suceeds to the duties of A. G. Gebhard.

J. M. PIERCE, general master mechanic of the Kansas City Southern, with headquarters at Pittsburg, Kan., has been appointed master mechanic at Shreveport, La., with jurisdiction over the Southern and Port Arthur Terminal divisions, succeeding L. C. Kirkhuff, who has been assigned to other duties. The position of general master mechanic has been abolished.

Car Department

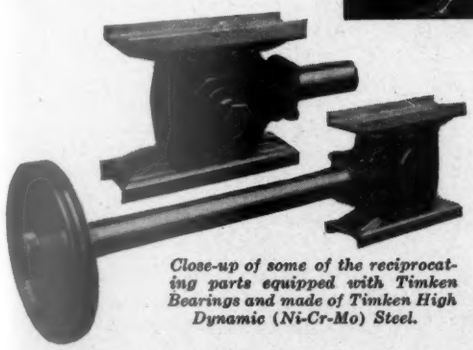
FRANK C. NOEL, formerly shop engineer of the Norfolk & Western at Roanoke,

(*Turn to next left-hand page*)

TAKE A TIP from TRANSPORTATION...

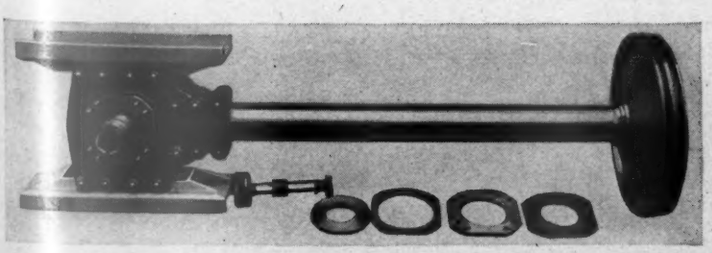
...on MONEY-SAVING with NICKEL ALLOY STEELS

● Meet the new "Commodore Vanderbilt", power plant of the New York Central's Twentieth Century Limited. A typical example this, of the modern trend in design and weight reducing which is boosting train speeds to better than 100 miles per hour. By using Nickel Alloy Steels in the running gear, shown at the right, more than 1,000 pounds were saved in the weight of reciprocating parts.



Close-up of some of the reciprocating parts equipped with Timken Bearings and made of Timken High Dynamic (Ni-Cr-Mo) Steel.

● In this particular Timken designed driving assembly, crossheads, pistons, piston rods, main and side rods, are made of tough, strong, enduring Timken High Dynamic (Ni-Cr-Mo) Steel because it permits the use of lighter sections without sacrificing the required mechanical properties. The high, strength-weight ratios of these steels permit economies in weight of materials used, increase pay-load capacity, lower fuel costs and reduce the wear and tear through the decrease of "hammer blow".



● Today, machinery of every kind can be made to perform more economically by the use of the Nickel Alloy Steels, both through their weight-saving advantages and their greater reliability. Not only do they lower costs through improved performance but they are ultimately economical because of their long service life. Our engineers are always at your service for consultation.

THE INTERNATIONAL NICKEL COMPANY, INC., NEW YORK, N.Y.

Va., has been appointed assistant foreman, passenger car shop.

JOHN J. O'BRIEN, superintendent of the car department of the Terminal Railroad Association of St. Louis, effective June 1, has at his own request been relieved of active supervision of car department matters and is appointed general car inspector. The duties relinquished by Mr. O'Brien will be assumed by Frank Ross, superintendent of motive power and equipment.

Shop and Enginehouse

A. CRAWLEY, day enginehouse foreman of the Wabash at Decatur, Ill., has been promoted to the position of general enginehouse foreman at Decatur.

Purchasing and Stores

WILLIAM R. CULVER, general storekeeper of the Chesapeake & Ohio, who has been promoted to superintendent of stores of this company, the New York, Chicago & St. Louis, and the Pere Marquette, with headquarters at Cleveland, Ohio, was born on July 15, 1884, at Tucson, Ariz. Mr.

William R. Culver

Culver entered railway service on July 1, 1902, with the Southern Pacific. On April 1, 1906, he was appointed assistant paymaster of the Southern Pacific of Mexico, holding this position until August 30, 1908, when he resigned to become division storekeeper of the National Railways of Mexico. On February 1, 1910, Mr. Culver rejoined the Southern Pacific of Mexico, being engaged on roadway accounting until March 31, 1911, when he was appointed chief of the material requisition bureau of the National of Mexico. On April 15, 1913, he left this company to go with the Pere Marquette as division storekeeper, being appointed traveling storekeeper in April, 1915, and general storekeeper in October, 1916. On August 1, 1917, Mr. Culver left railway service to become manager of factory sales of the Willys-Overland Automobile Company. Later he served with the Earle Motor Car Company as purchasing agent and supervisor of stocks. He re-entered railway service on August 1, 1923, as general storekeeper of the Pere Marquette. On November 1, 1931, he was made general storekeeper of the C. & O.

Obituary

KARL J. GOEBEL, general car foreman of the Delaware, Lackawanna & Western, with headquarters at Elmira, N. Y., died on June 8 of a heart attack, at the age of 43.

C. H. TEMPLE, who retired on September 1, 1928, as chief of motive power and rolling stock of the Canadian Pacific, with headquarters at Montreal, Que., died on May 29 at the age of 75.

MICHAEL J. COLLINS, general purchasing agent of the Atchison, Topeka & Santa Fe, with headquarters at Chicago, died of heart disease on June 6 at his home at Chicago. Mr. Collins was 76 years of age and had been in railroad service for about 60 years, 50 years of which were spent with the Santa Fe.

ELDRED D. TOYE, general storekeeper of the Central region of the Canadian National with headquarters at Toronto, Ont., died on May 20, at his home following a brief illness. At the time of his death, Mr. Toye was a member of the General committee of the Purchases and Stores division of the Association of American Railroads.

GEORGE F. WILSON, formerly superintendent of motive power and equipment of the Chicago, Rock Island & Pacific, who retired from active service in 1910 as purchasing agent of the Delaware, Lackawanna & Western, died at Atlantic City, N. J., on June 29. Early in his railroad career Mr. Wilson served as a master mechanic on the Minneapolis & St. Louis, leaving this company in March, 1889, to become assistant general master mechanic of the Chicago, Kansas & Nebraska (part of the Rock Island) at Horton, Kan. Later he served as assistant general master car builder of the C. K. & N., and on October 7, 1889, became acting general master mechanic of the Rock Island. In February, 1890, Mr. Wilson was appointed general master mechanic, which position he held until June 8, 1891, when he became superintendent of motive power and equipment. In 1903 he left the Rock Island to become purchasing agent of the Delaware, Lackawanna & Western.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

ELECTRIC HEATING UNITS AND DEVICES.—Publication GED-650 of the General Electric Company, Schenectady, N. Y., lists small heating units of all kinds for industrial plants.

SHEET METALS.—Sections on U.S.S. galvanized sheet, black sheet and stainless steel are contained in the 64-page illustrated booklet issued by the Carnegie-Illinois Steel Corporation, Pittsburgh, Pa.

PORTABLE CRANE TRUCKS.—The four-page bulletin issued by The Elwell-Parker Electric Company, Cleveland, Ohio, illustrates and gives specifications for four types of portable crane trucks ranging in capacity from 1,000 to 10,000 lb.

WIRE SCREEN AND FILTER CLOTH.—The International Nickel Company, Inc., 67 Wall street, New York, has issued a 14-page booklet descriptive of the use of Monel for industrial screen and filter cloth problems.

MACHINING METALS.—The International Nickel Company, Inc., Development and Research Division, 67 Wall street, New York, has issued Bulletin T-12 descriptive of the machining of Monel, nickel and Inconel.

GRADE-O-METER.—A six-page folder descriptive of the Grade-O-Meter, an instrument for mechanically testing the strength of the bond of grinding wheels, etc., has been issued by the Abrasive Engineering Corporation, Stephenson building, Detroit, Mich.

MILLING CUTTERS.—National Adjusto-Lock inserted blade milling cutters are listed and described in the eight-page booklet issued by the National Twist Drill & Tool Co., Detroit, Mich. Positive locking of blades in any position and universal adjustment feature these cutters.

SEAMLESS FLEXIBLE TUBING.—The sixteen-page illustrated booklet, Bulletin SS-3, of The American Brass Company, American Metal Hose Branch, P. O. Box 791, Waterbury, Conn., discusses the essentials of construction and advantages of American Seamless flexible tubing and shows many typical installations.

OXYACETYLENE FLAME HARDENING.—The Airco process of flame hardening plain carbon steels, low-alloy steels, and certain semi-steels and low-alloy cast irons common to machine construction is discussed and its applications illustrated in the attractive 16-page booklet issued by the Air Reduction Sales Company, 60 East Forty-Second street, New York.

AIR-MAZE AIR FILTERS.—The Air-Maze Corporation, 812 Huron Road, Cleveland, Ohio, is distributing its 1937 catalog of Air-Maze industrial air filters for application on Diesel, semi-Diesel, gas and gasoline engines; air compressors; air-conditioning systems, etc. A four-page folder describes Air-Maze filters for railroad use.

"HANDBOOK OF COMMON MACHINE FASTENERS."—The Handbook of Common Machine Fasteners issued by The Russell, Burdsall & Ward Bolt and Nut Company, Port Chester, N. Y., consists of 20 pages of a size to fit into the average drawing instrument case. It illustrates the method of drawing various types of bolts, nuts and rivets and is intended for those interested in the proper designs of such products for drafting work.